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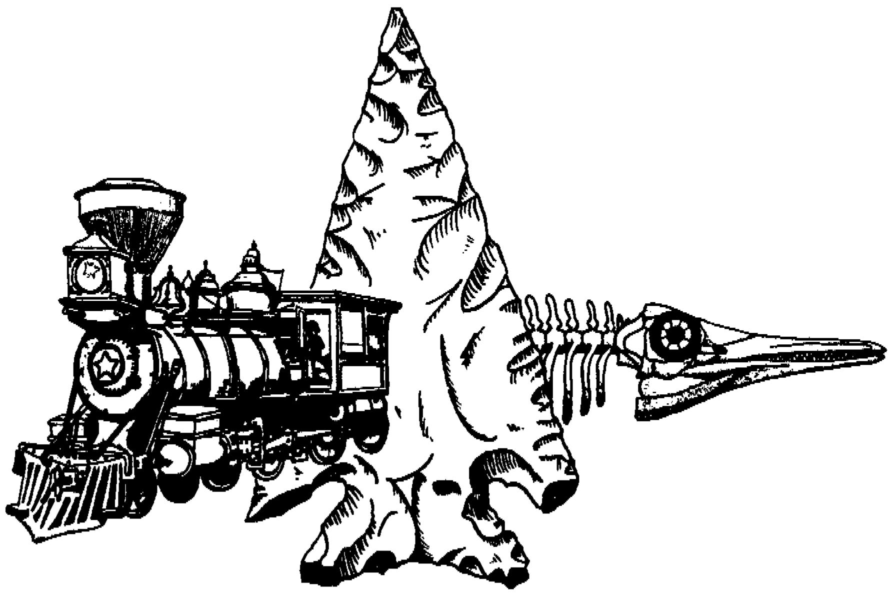

AN ARCHAEOLOGICAL SURVEY IN THE MORMON MOUNTAINS LINCOLN COUNTY, NEVADA

Mary K. Rusco
Jeanne Muñoz

TECHNICAL REPORT NO. 11

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RENO, NEVADA 1983

FOREWARD

"An Archaeological Survey in the Mormon Mountains, Lincoln County, Nevada" by Mary K. Rusco and Jeanne Muñoz presents the results of a BLM cultural resources contract awarded to Chambers Consultants and Planners, Stanton, California in 1982. The Bureau requested a sample survey of a mountainous area located 60 miles northeast of Las Vegas in the geologic overthrust region of Nevada. The overthrust region has experienced a great deal of oil and gas exploration activity in recent years. Past limited archaeological reconnaissances in the Mormon Mountains have indicated a potentially rich archaeological record. Therefore, the Bureau sought to gain a more systematic inspection of the region so that requirements for archaeological field surveys prior to future exploration and development projects may be more judicially applied.

As revealed by the field survey, a striking feature of the archaeological record in this mountainous region of southern Nevada is the relatively low frequency of open, lithic scatters compared to the occurrences of rockshelters, caves, rock art and roasting pit features. This phenomenon no doubt reflects the long term role the Mormon Mountains have played in the adaptive strategies of past populations inhabiting the region. Data gathered from the Mormon Mountain project supplements information gathered by other regionally oriented projects recently conducted in the surrounding lower elevation environmental zones, including the Muddy River Valley. This broad data base shall aid in preserving archaeological resources through management decisions made from a regional perspective.

Richard C. Hanes
Nevada BLM State Archaeologist
Reno

October, 1983

Library, Bureau
of Land Management

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AN ARCHAEOLOGICAL SURVEY IN THE MORMON MOUNTAINS, LINCOLN COUNTY, NEVADA

by

Mary K. Rusco and Jeanne Muñoz
with contributions by
Jonathan O. Davis, Eileen M. Green, and Ivan Show

Prepared for:

UNITED STATES DEPARTMENT OF THE INTERIOR
Bureau of Land Management
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Stanton Rolf, Contracting Officer's Authorized Representative for the Bureau of Land Management (COAR), provided support, enthusiasm, and assistance throughout the Mormon Mountains Class II Survey. Consultant Archaeologist Margaret Lyneis was involved throughout the project, and her objective criticism, intellectual insight, and enthusiasm are deeply appreciated. Consultant Statistician Ivan Show deserves credit for the basic sampling design, and Consultant Geologist Jonathan Davis contributed the geological expertise necessary for the success of a study of this sort. Paiute Ethnohistorian Ed Johnson provided not only his knowledge, but sense of humor as well.

Ron Reno and Alvin McLane served as field crew chiefs, and crew members included Philip Baumkratz, Rod Brown, Bob Clerico, Bob Ellis, Eileen Green and Keith Myhrer. Eileen Green was crew chief during the last part of the fieldwork. Needless to say, the survey could not have been accomplished without their hard work, sometimes under very difficult situations.

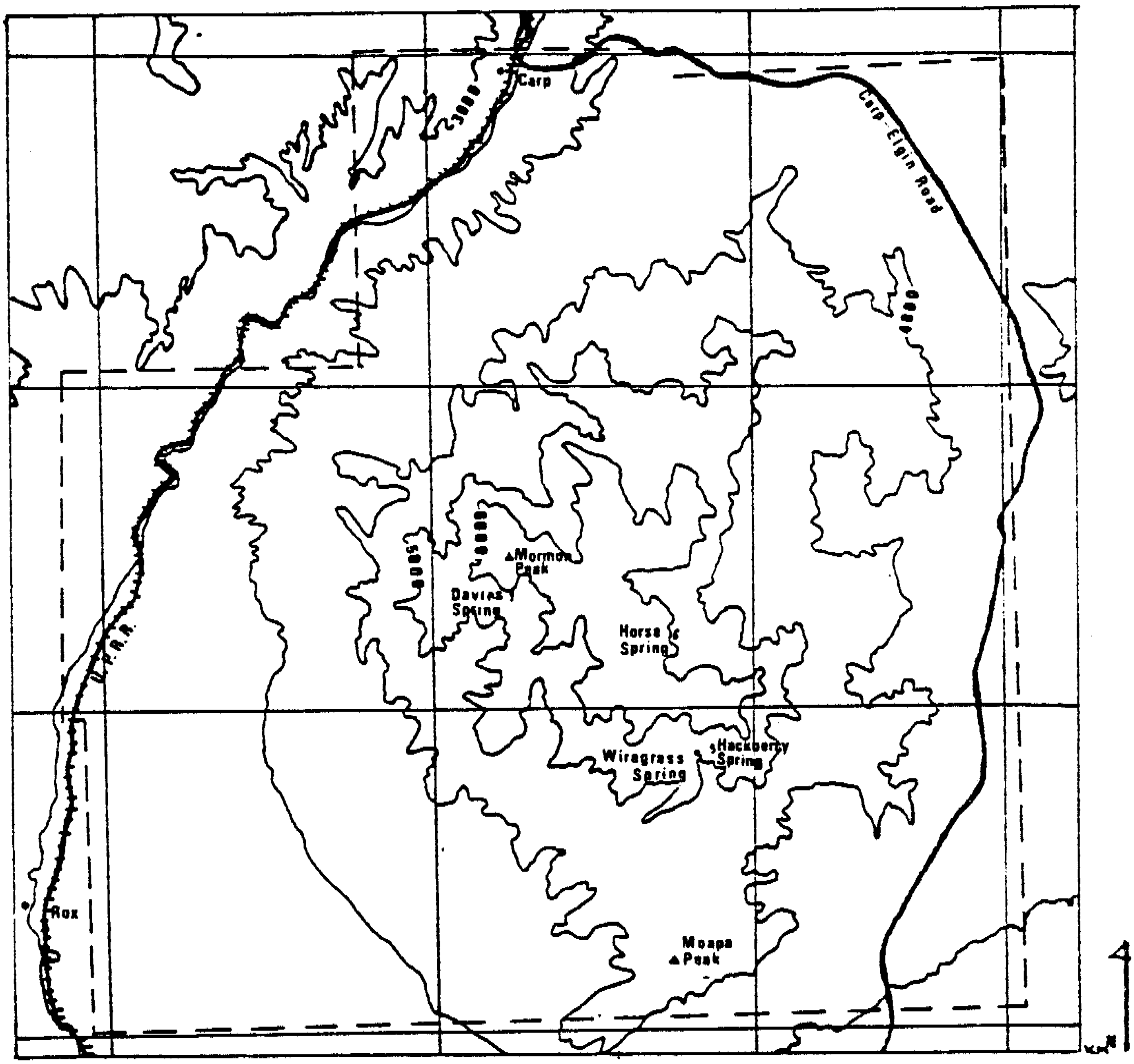
Eileen Green, Ron Reno and Lauren Ruffner assisted in the preparation of the draft inventory records and maps. Eileen Green prepared the text on rock art. Ron Reno assisted in the brief evaluation of historic sites. Pat Olsen, Lost City Museum, consulted on the classification of ceramics. To that end she participated in the final brief field session. Various colleagues read the Final Draft, including Richard Hanes and Stanton Rolf, Bureau of Land Mangement; Richard Brooks and Robert Ellis, Museum of Natural History, University of Nevada, Las Vegas. We are grateful for their comments. Preliminary and final drafts were typed by Pam Finch.

The following institutions supplied background information, including site records and unpublished manuscripts: the Bureau of Land Management, Las Vegas; Special Collections Library, University of Nevada, Las Vegas; Nevada State Historical Society, Carson City and Las Vegas; Records, Archaeological Research Center, University of Nevada, Las Vegas. Herbert Meyers, Moapa Reservation, was generous with his time, accompanying the Principal Investigators on a trip through part of the project area.

We wish to extend our thanks to all of these institutions and individuals.

Mary K. Rusco
Nevada State Museum, Las Vegas

Jeanne Muñoz
Chambers Consultants and Planners



MAP OF PROJECT AREA SHOWING THE LOCATION OF
SPRINGS, MAJOR PEAKS AND PLACE NAMES

Section 1

INTRODUCTION

This report describes the results of a Class II Cultural Resources Survey performed by Chambers Consultants and Planners for the Bureau of Land Management (BLM), Las Vegas District. The BLM's stated purpose for the survey was as follows:

> For oil and gas exploration compliance purposes and planning purposes, the Las Vegas District proposes to conduct a Class II, Stratified Probability - (random) Sample of BLM - administrated lands within the Mormon Mountains portion of the Oil and Gas Overthrust Belt, within Lincoln County of the Las Vegas District. The Class II Inventory is designed to obtain a meaningful and representative sample of all cultural resources within the Mormon Mountain area of the overthrust belt within the Las Vegas District (RFP No. YA-553-RFP2-1036: Section F.2.1).

The results of the survey are presented in this report, preceded by a description of the environment of the Mormon Mountains, including water resources, vegetation, fauna, and geology (Section 2, Environmental Background).

The survey was guided by a combined stratified random/intuitive or judgmental sampling design (discussed in Section 3, Sampling Design) devised by Project Statistician Ivan Show, in collaboration with Co-Principal Investigator Rusco, Consultant in Archaeology Margaret M. Lyneis, and Consultant in Geology Jonathan O. Davis, and was carried out in six field sessions between October 30, 1982 and March 15, 1983. The methods used in carrying out the sampling design are described in Section 4.

Section 5 contains the results of the field reconnaissance, with descriptions of the sites, quantitative and qualitative manipulation of the inventory data, and an evaluation of the results. A synthesis of the data from this and previous cultural resource studies in the Mormon Mountains area is also presented in Section 5. Perceived patterns and relevant cultural processes are described and discussed, and contributions to the region's cultural history are pointed out, all in the context of the Archaeological Element for the Nevada Historic Preservation Plan (1982).

Management options and research directions are suggested in Section 6. The probability of continued oil and gas explorations in the Mormon Mountains poses real management problems for the Bureau of Land Management, and cultural resource management needs are addressed here in the context of more academically oriented research goals.

In sum, the report is a project area-specific research design set in the context of the Prehistoric Southern Nevada Study Units of the Archaeological Element for the Nevada Historic Preservation Plan (1982) and oriented toward BLM management considerations.

There are three appendices to this report. The first is a report on the involvement of contemporary Native Americans of the Mormon Mountains area in the Class II Survey proceedings. Appendix II is a brief historical overview of the Mormon Mountains project area, and Appendix III (bound separately) is a summary of the site inventory.

A deliberate attempt has been made throughout the work to avoid unnecessary technical language and esoteric concepts so that the end product can be used by both the non-professional and professional for a variety of needs.

Section 2

ENVIRONMENTAL BACKGROUND

The jagged skyline of the Mormon Mountains is a distinctive Southern Nevada landmark, located slightly over 100 km northeast of Las Vegas, and predominantly in Lincoln County. The range is bounded on the west by Meadow Valley Wash, the north by the Tule Desert, the east by the East Mormon Range, and the south by the Mormon Mesa.

In elevation the range extends over 2,600 m (8,500 ft) from under 900 m (3,000 ft) in the Meadow Valley Wash to the top of Mormon Peak at 3,303 m (10,839 ft). The two highest peaks are Mormon or Davies Peak and Moapa or Jack's Peak (3,057 m or 10,032 ft). A narrow valley (2 to 3 km wide and 11 km long) separates the Mormon and East Mormon ranges. Except for this valley and three small stretches of the Meadow Valley Wash, most of the project area is mountainous or consists of dissected piedmont. Well over half of the area is above 1,700 m (5,580 ft) in elevation.

The terrain of the project area was described colorfully by a climber who scaled its mountains as an "array of wild rocks...cut by numerous deep canyons and gorges; sharp limestone peaks jut skyward and cliffs drop sheer more than 800 feet" (McLane 1975:2).

2.1 WATER

Although precipitation in the Mormon Mountains is mapped at over 8 in., with over 12 in. at the highest elevations (Nevada Division of Water Resources 1972), the range provides little surface water much of the year. Major springs mapped by the USGS are Davies Spring at 2,816 m (9,241 ft) in elevation, Horse Spring at 2,683 m (8,804 ft), Wiregrass Spring at 2,636 m (8,650 ft), and Hackberry Spring at 2,532 m (8,309 ft), (USGS 7.5' topographic maps of Rox NE and Moapa Peak NW, Nevada, 1969). Except for Davies, all were dry when visited by archaeological field crews in November, but provide water ephemerally as do some seeps and shallow solution cavities in the limestone bedrock (tanks or tinajas). The latter are rare in the Mormon Mountains compared to the Muddy Mountains or the southern part of the Spring Range where the Aztec sandstone formation has many such cavities. Deep washes support desert riparian vegetation as described by Bradley and Deacon (1967:226), but are only ephemeral sources of water. Meadow Valley Wash is shown on USGS maps as intermittent below the narrows northeast of Vigo, near the center of the Mormon Mountain Range along its north-south axis. Northeast of that point the wash is today a year-round water source. Seasonal flooding and occasional major flash floods plague local ranchers and the Union Pacific Railroad company whose tracks run along the wash.

The eastern slope of the mountains is particularly dry and steel stock tanks maintained by ranchers who lease grazing rights from the BLM are frequented by bighorn sheep as well as by burros, wild horses and cattle. Numerous water collection devices (guzzlers) built and maintained by the BLM are the main water sources for smaller fauna. Two of the stock tanks are home for some gold fish, the only creatures of their kind who inhabit the Mormon Mountains.

Rain and snowfall are generally light, and most precipitation is predominantly between late November and early June. As in the rest of the region, however, torrential rainstorms may occur in the mountains during any season, and the resulting flash floods have sculptured the deeply dissected piedmont zones.

2.2 VEGETATION

Both Great Basin and Sonoran vegetation are present in the project area. Major biotic communities include juniper-pinyon, blackbrush (particularly the Joshua tree association) and creosote bush as described for Southern Nevada by Bradley and Deacon (1967:212-218).

Pinyon is present but not abundant in the northcentral portions of the range above 2,260 m (7,413 ft) in elevation. Juniper is both more widespread and, where the forest is mixed with pinyon, juniper predominates except for some pinyon groves above 2,800 m (9,187 ft). An understory of big sagebrush and other plants of the community is present. At least one fossil pack rat midden with juniper needles was observed by the archaeological crew at an elevation of 1,800 m (5,907 ft) and a linear distance of over 4.5 km (2.8 mi) from the nearest juniper today.

A small stand of Ponderosa pine is present at Mormon Peak, a relict of the more extensive Late Quaternary forest.[1] At the Yellow Man Cave site near Hackberry Spring, needles of a pine other than pinyon were observed in a fossil pack rat midden. This site is 393 m (1,290 ft) lower in elevation and over 7.5 km (4.7 mi) from the relict pine stand.

More extensive (approximately 67,000 acres) is the blackbrush community, present in the project area mostly between 1,700 and 2,650 m (5,580 and 8,700 ft) in elevation. Joshua trees (*Yucca brevifolia*) are scattered or sparse over most of the slopes at the lower extent of their range, but in places, dense Joshua tree forests are present with an understory of other yuccas (*Y. baccata* and *Y. schidigera*) and various cacti.

At elevations between 1,400 and 1,700 m (4,600 and 5,580 ft), the blackbrush community is gradually replaced by associations of the creosote

[1]This stand was first reported by Howard Booth, Sierra Club, who saw them in 1978 (Hart 1981:140).

bush community. Sparse and low shrubs cover most of this area, the lower colluvial slopes of the range. Only in deep flat-bottomed washes with Holocene alluvial terraces are tall (over 2 m or 6.5 ft high) creosote bushes found along with wash willow, occasional big sage (at higher elevations) and other shrubs of the desert riparian community. Along the ledges below steep cliffs in the uplands, these more phreatophytic plants also occur (cf. Bradley and Deacon 1967:221).

The major prehistoric plant resource of the area was apparently the agave (*Agave utahensis*). Archaeological field crews found this plant at nearly all elevations in the project area. Its presence is uniformly associated with surface outcrops of limestone and negatively with Quaternary or recent alluvium. A good geological map would thus show where in the range this major vegetal resource of the prehistoric human population can be expected.

In addition to plentiful agave, aboriginal populations could have collected a variety of medicinal plants, including *Yerba santa* and *Thamnosus montana* (turpentine weed). Desert almond (*Prunus* sp.) is widespread in the area, a food resource for small mammals today which may have been harvested by prehistoric human populations. *Ephedra* spp. or Indian tea is present also in relatively large stands. Today, pinyon does not attract pine nut gatherers to the area, although some large stands are present and the seed may have been harvested prehistorically.

2.3 FAUNA

Bradley and Deacon (1967) describe the fauna characteristic of each of the plant communities represented in the project area (Table 2-1). Archaeological field crews noted occasional jackrabbits, cottontail rabbits, ground squirrels, coyotes, burros and at least one deer. Mountain sheep were sighted four times and recent skulls and other skeletal elements were observed. Birds including raptors, ravens, doves and rock wrens were seen, the latter being by far the most numerous. In general, however, the cattle and wild horses appear to be the dominant fauna at elevations below 1,800 m (5,906 ft) and up some of the larger canyons.

Mountain sheep and deer provide an interesting prehistoric distribution problem both for wildlife biologists and archaeologists. A known population of at least 240 sheep and 50 deer are present in the range today.[2] Management of their habitat is a concern for the Bureau Wildlife Specialists, and the large artiodactyls are reportedly poached now with some regularity.

Charred and butchered bones of artiodactyl size have been recorded by archaeological crews on the surface of some caves and rockshelters in the

[2] Before a "die-off" 3 years ago the sheep herd numbered approximately 400 (BLM Wildlife Management Specialist, personal communication); see McQuivey (1978:46).

Table 2-1
FAUNA COMMONLY PRESENT IN BIOTIC COMMUNITIES OF THE PROJECT AREA

Fauna		Lower Sonoran Communities		Upper Sonoran Communities
Common Name	Scientific Name	Creosote Bush	Blackbrush	Juniper Pinyon
REPTILES:				
Lizards:				
Side-blotched lizard	*Uta stansburiana*	P	P	-
Desert Whiptail lizard	*Cnemidophorus tigris*	P	P	-
Zebra-tailed lizard	*Callisaurus draconoides*	P	-	-
Desert Horned lizard	*Phyrnosoma platyrhinos*	P	-	-
Desert Iquana	*Dipsosaurus dorsalis*	P	-	-
Desert Spiny lizard	*Sceloporus magister*	P	P	-
Western Fence lizard	*S. occidentalis*	-	-	P
Sagebrush lizard	*S. graciosus*	-	-	P
Leopard lizard	*Crotophytus wislizeni*	P	-	-
Collared lizard	*C. collaris*	-	P	-
Yucca night lizard	*Xantusia vigilis*	-	P	-
	Eumeces gilberti	-	-	P
Snakes:				
Sidewinder	*Crotalus cerastes*	P	-	-
Desert rattlesnake	*C. mitchelli*	P	P	P
Gopher snake	*Pituophis melanoleucus*	P	P	P
Red racer	*Masticophis flagellum*	P	P	-
Other Reptiles:				
Gila monster	*Heloderma suspectum*	P	-	-
Desert tortoise	*Copherus agassizi*	P	-	-

Table 2-1 (Continued)
FAUNA COMMONLY PRESENT IN BIOTIC COMMUNITIES
OF THE PROJECT AREA

Fauna		Lower Sonoran Communities		Upper Sonoran Communities
Common Name	Scientific Name	Creosote Bush	Blackbrush	Juniper Pinyon
RODENTS:				
Squirrels				
Antelope ground squirrel	*Cittelus levcurus*	P	P	-
Rock squirrel	*C. variegatus*	-	-	P
Round-tailed ground squirrel	*C. tereticaudus*	P	-	-
Kangaroo rats:				
Merriam's kangaroo rat	*Dipodmys merriami*	P	P	-
Desert kangaroo rat	*D. deserti*	P	-	-
Pocket mice:				
Long-tailed pocket mouse	*Perognathus formosus*	P	P	
Great Basin pocket mouse	*P. parvus*	-	-	P
Little pocket mouse	*P. longimembris*	P	P	-
Deer mice:				
Cactus mouse	*Peromyscus eremicus*	P	P	-
Deer mouse	*P. maniculatus*	-	P	P
Canyon mouse	*P. crinitus*	-	P	P
Packrats:				
Desert wood rat	*Neotoma lepida*	P	P	P
Other Rodents:				
Grasshopper mouse	*Onychomys torridus*	P	P	-
RABBITS:				
Desert jackrabbit	*Lepus californicus*	P	P	-
Desert cottontail	*Sylvilagus audubonii*	P	P	-

Table 2-1 (Continued)
FAUNA COMMONLY PRESENT IN BIOTIC COMMUNITIES
OF THE PROJECT AREA

Fauna		Lower Sonoran Communities		Upper Sonoran Communities
Common Name	Scientific Name	Creosote Bush	Blackbrush	Juniper Pinyon
CARNIVORES:				
Coyote	Canis latrans	P	P	P
Kit fox	Vulpes macrotis	P	P	-
Grey fox	Urocyon cinereo argenteus	-	-	P
Badger	Taxidea taxus	P	P	-
Bob cat	Lynx rufus	P	P	P
ARTIODACTYLS:				
Desert bighorn sheep	Ovis canadensis	-	P	P
Mule deer	Dama hemionus	-	-	P

project area (McLane, 1976; Mormon Mountain project field notes 1982-1983). How old these specimens are is not known, however.

Mountain sheep require a large amount of water and reliable water sources accessible from their preferred rocky upland habitat. Ephemeral seeps and tinajas are present, but not numerous in the range today, and the springs are currently dry or seasonal. Today mountain sheep rely on stock tanks and guzzlers.

Presumably water was available to them year round before ranching and systematic wildlife management was introduced, but perhaps the burned and butchered bone on the surface of archaeological sites are relatively recent specimens.

The location of fossil and active pack rat (Neotoma spp.) middens was recorded on site records because of their potential value for paleoenvironmental data (cf. An Archaeological Element for the Nevada Historic Preservation Plan 1982:18-20).

2.4 GEOLOGY (By Jonathan O. Davis, Desert Research Institute)

The bedrock geology of the Mormon Mountains has been briefly described by Tschanz and Pampeyan (1970) and paraphrased by McLane (1976). The mountain range comprises about a thousand meters of paleozoic carbonate rock overlying (with thrust contact) older Precambrian igneous and metamorphic rocks, as well as some Cambrian shale and quartzite. The Cambrian and Precambrian rocks are exposed only in two small windows, at Hackberry Spring and west of Mormon Peak. The bulk of the range is a broad, deeply dissected dome of limestone and dolomite. Flanking the mountain mass are piedmonts which slope fairly smoothly down towards Meadow Valley Wash on the west, Mormon Mesa to the south, and the Tule Desert to the east.

The piedmonts are comprised of late Cenozioc sediments, mostly derived from the erosion of the Mormon Mountains, and are in effect a palimpsest of deposits ranging in age from the Miocene Muddy Creek Formation -- exposed along Meadow Valley Wash and the Virgin River and underlying Mormon Mesa -- to modern rocky alluvium in the bottoms of recent washes. Due both to the dry climate of the area and to the abundant supply of calcium carbonate in the sediment, older sedimentary units are typically capped by caliche up to several meters thick, and younger units are typically cemented by calcium carbonate. Although detailed mapping of the sediments was beyond the scope of this project, several units can be delineated on aerial photographs, and along major washes (e.g., Toquop Wash) a sequence of several alluvial terraces is present.

The degree of dissection of the piedmont sediments served as the basis for delineation of two sampling strata for this project: Stratum 5 comprises fairly smooth, undissected piedmonts, underlain by caliche, on which sight distance is long, travel easy, and soils are strongly affected by the impermeable caliche below; Stratum 4 comprises the heavily dissected parts of the piedmont where headward erosion from Meadow Valley Wash has breached the caliche and the terrain is a badland of gullies and divides, sight distance is comparatively short, travel across the grain of the drainages is nearly impossible, and soil profiles are shallow but developed upon the sediments of the piedmont instead of the caliche.

In the initial planning of the project, it was hoped to delineate a stratum including those washes with terraces visible on aerial photographs; however, this was not practical. The idea was that the terraces might be evidence of an alluvial sedimentary record of the late Pleistocene and Holocene, and therefore might contain buried, stratified sites. Brief examination of these features in the field, however, suggests that the terraces are considerably older than this; similar terraces on the Nevada Test Site to the west contain the Bishop ash, which is about 700,000 years old (Hoover et al. 1981). Nonetheless, these washes proved interesting archaeologically for another reason.

The terraces along the major washes (e.g., Toquop Wash) are capped by layers of sediment which are cemented by carbonate, and the risers of the terraces rise as much as 10 m vertically, where the modern washes have been eroding at their bases. In several localities, rockshelters (or "caliche caves") were found in the terrace risers, and some of these proved to be archaeological sites. The mode of formation of these "caliche caves" seems to involve initial scooping out of an overhang by running water and rocks in the wash, but the location and form of the caves suggests that they have been modified and enlarged by the wind. The "caliche caves" provide a form of shelter along washes in localities where natural shelter may otherwise be lacking, and their location can be fairly well predicted from aerial photographs.

The bedrock geology of the Mormon Mountains provides the basic resource framework for human use of the area. The paleozoic limestone and dolomite has been subject to solution through geologic time, with two important results: there are many caves in the rock, which may serve as shelter for humans or animals; and the rock is very porous, so that surface runoff is quickly diverted underground. Little is known about the ground water hydrology of the Mormon Mountains, but it seems likely that most of the precipitation received by the range quickly runs underground, so that streams flow rarely, and springs are few. The carbonate bedrock also provides suitable soil chemistry for agave, and the igneous and metamorphic rocks beneath the carbonates have attracted miners and prospectors during historic time.

Section 3

SAMPLING DESIGN
(by Ivan Show)

3.1 OBJECTIVES AND BACKGROUND

The objective of this study, from the statistical design point of view, was to produce a random stratified sample of survey units within the Mormon Mountain Study Area. The major restriction on the design was the requirement for sampling 8 percent of the study area.

Stratified sampling meets both research and cultural resource management goals effectively when the strata are defined on the basis of extant and significant environmental variables: topography, geomorphology, biogeography, etc. The more closely the environmental factors relate to archaeological variables of interest, the more closely the stratified sample design meets the desired goals. This relationship permits managers to make land use management decisions on the basis of cultural resource information that has been organized on the same geographical factors that determine many of the proposed land uses: slope, access, soils, vegetation, presence or absence of water. The relationship also permits the organization of archaeological data in a form appropriate for its application to a variety of current research topics in the southern Great Basin; these generally require information about the distribution of sites on the landscape.

3.2 THEORY

In this section, we formally present the mathematical procedures underlying stratified random sampling. Some rationale for the choice of procedures is also given. Each term used in the discussion is defined as it arises.

Sample units are the size and shape of township 1/4-sections (160 acres) as shown on USGS 7.5' topographical maps. The sampling universe is all such units lying within the Mormon Mountain Study Area. In stratified sampling, the sampling universe of N units is divided into mutually exclusive and exhaustive strata of sizes N_1, N_2, ..., N_n such that

$$N_1 + N_2 + \ldots + N_n = N \quad (1)$$

All strata sizes (N_i) must be known. A sample is selected randomly and independently from each strata; these sample sizes are denoted as n_1, n_2, ..., n_n.

Except for some cases of purely academic interest, stratification may result in increased precision with which population parameters are estimated. This gain is particularly striking if the sampling universe can be divided into strata that are internally less variable than the overall population. The purpose of stratified sampling is therefore to minimize or eliminate among-strata variability.

Two basic methods of sample size allocation are available: proportional and optimum allocation. In proportional allocation

$$\frac{n_i}{n} = \frac{N_i}{N} \tag{2}$$

where $n = n_1 + n_2 + \ldots + n_n$. This means that the sample size in each stratum is proportional to the size of the stratum. The result is a self-weighting sample with mean

$$\bar{y}_{st} = \sum_{i=1}^{n} \frac{n_i}{n} \bar{y}_i \tag{3}$$

(where subscript "st" indicates stratified) and variance

$$V_{prop}\left(\bar{y}_{st}\right) = \sum_{i=1}^{h} \left(\frac{N_i}{N}\right) \frac{S^2_i}{n} - \sum_{i=1}^{h} \left(\frac{N_i}{N}\right) S^2_i \tag{4}$$

where

$$S^2_i = \frac{1}{N_i - 1} \sum_{j=1}^{n_i} Y_{ij} - \bar{y}_i^{\;2} \tag{5}$$

In optimum allocation for fixed maximum sample size,

$$\frac{n_i}{n} = N_i S_i \Bigg/ \sum_{i=1}^{n} N_i S_i \tag{6}$$

This means that the sample size in each stratum is proportional to the size of the stratum weighted by the standard deviation of the stratum. The mean is the same as for proportional allocation, but the variance is now

$$V_{opt}\left(\bar{y}_{st}\right) = \sum_{i=1}^{n} \left(\frac{N_i}{N}\right)^2 \frac{S_i^2}{n_i} \qquad \sum_{i=1}^{n} \left(\frac{N_i}{N}\right) \frac{S_i^2}{N} \tag{7}$$

The second terms on the right in equations (4) and (7) are the contributions of among strata variance mentioned above.

A major alternative to proportional or optimum allocation and one that must be mentioned in order to make our rationale acceptable is a simple random sample with mean

$$\bar{y} = \frac{1}{n} \sum_{i=1}^{n} y_i \tag{8}$$

and variance

$$V_{ran}\ (\bar{y}) = \left(1 - \frac{n_i}{N}\right) \frac{S^2}{n} \tag{9}$$

By comparison of equations (4), (7), and (9), it can be shown that

$$V_{opt} \leq V_{prop} \leq V_{ran} \tag{10}$$

except in cases where the actual allocation of the n_i departs radically from proportional or optimum.

The impact of equation (10) is that we would wish to use optimum allocation in order to establish a no-lose situation for sampling precision. We must, however, obtain estimates of N_i and S_i and, further, must devise a method for randomly choosing n_i samples in each stratum. These problems are all nontrivial; they are dealt with in the section on application. Optimum allocation leads to the following two rules of conduct:

1. If a stratum is larger, take more samples in that stratum;

2. If a stratum is more variable, take more samples in that stratum.

3.3 APPLICATION

The project area was stratified for the purpose of the sample survey. Stratification was based on the geological - vegetation zones that are believed to have structured prehistoric and historic land use in the region.

Six strata were defined:

1. Mountains with juniper-pinyon coverage: with a margin of 100-200 m (325-650 ft), as mapped by the USGS on 7.5' topographic sheets;

2. Mountains that support the blackbrush community: including at higher elevations the _Yucca brevifolia_ association;

3. Embayed mountains, also with blackbrush community: including the _Y. brevifolia_ association;

4. Heavily dissected piedmont: predominantly in the northwest and western portions of the project area, sloping to the Meadow Valley Wash, supporting the creosote bush community;

5. Piedmont: in contrast to stratum 4, this stratum of the piedmont zone of the Mormon Mountains is somewhat more gently sloping and less heavily dissected; it too supports the creosote bush community; the basis for stratification here is that the project geologist postulated variation in biotic associations due to soil differences as well as stratum-specific prehistoric land-use due to the dissection of the terrain; vegetation maps prepared by the Bureau of Land Management show this difference; and

6. Meadow Valley Wash, with a margin of 200 - 300 m (650 - 980 ft). This wash captures the intermittent runoff from all washes in the northwestern and western slopes of the Mormon Mountains. The wash is a year round surface water source above the narrows near Vigo. It is shown as intermittent below that point on the USGS 7.5' topographic maps, but had running water during our field-work. From time to time Meadow Valley Wash is the scene of major flash floods. The wash supports a dense riparian vegetation and, particularly in places where the railroad bed serves as a levee, marsh vegetation is present. Prehistorically marshes may also have occurred in ox bows. The wash is the route of the Union Pacific Railroad and the Glendale to Caliente road through the mountainous area.

Three factors were considered for the allocation of samples to strata: management needs, efficiency or cost of sampling, and archaeological site variability. Since management needs did not otherwise appear to be of major concern, they were dropped from further consideration with the concurrence of the BLM. Similarly, efficiency/cost was found to be overwhelmingly outweighed by research considerations; this factor was therefore dropped. To further illuminate these decisions, consider a preliminary review in which all factors were considered. The highest management priority, lowest cost, and greatest expected frequency and variability of site types all coincided with stratum five, the piedmont. The end result would have been an inordinately large proportion of the sampling effort expended in that stratum, an area of expected low site density. The problem was not so much that the piedmont would receive so much attention, but that other areas of equal or even greater interest would be proportionately neglected. Therefore, stratum sample sizes were allocated according to stratum size and variability only, as outlined in the section on theory.

Having made the above decision, our first major problem was to obtain estimates of stratum sizes. This was accomplished by replicated planimetry of USGS 7.5' topographical maps. The number of acres measured in each stratum were as follows:

1. 25,590 acres
2. 67,200 acres
3. 12,270 acres
4. 32,510 acres
5. 47,070 acres
6. 3,060 acres

The other major problem was to obtain estimates of within-stratum archaeological site variability. We addressed this problem as follows. In a sampling situation dealing with discrete entities occurring randomly within a circumscribed area, the appropriate statistical distribution describing the process is called Poisson. This distribution has the property that the mean is equal to the variance. Where a set number of samples taken, therefore, the variance is also related to the total number of discrete entities in the circumscribed area. We believed that we were dealing with just such a Poisson process and that a good measure of the within-stratum variability was the frequency of different types of sites occurring within the strata. In addition, equation (6) above indicates that we need only a measure of the relative frequency of site occurrence, further simplifying our problem. The following table of coded relative frequencies was constructed and the resultant total relative frequency used as an estimate of relative within-stratum archaeological site variability.

Site Variable	Stratum 1	2	3	4	5	6
Caves and shelters	1	1	1	1	1	1
Rock art	1	1	1	1	1	1
Lithic scatters	2	2	2	1	1	1
"Isolated finds"	2	2	2	2	2	2
Roasting pits	0	1	0	0	2	0
Ceramics (with scatters)	1	1	0	0	2	2
Pueblos	0	0	0	0	0	1
Historic (Anglo)	1	1	0	0	1	2
TOTALS	8	9	6	5	10	10

In the above table the following relative frequency codes were used:

0 - absent or nearly so,
1 - present but not abundant
2 - abundant

Maximum sample size (n) was set at 8 percent of the project area or 94 1/4-sections. The following summarizes the information and calculations used to obtain the optimum sample size allocation to strata based on equation (6).

n = 94
N = 187,708

Stratum	N_i	S_i	N_iS_i	n_i
1	25,589.8	8	204,718.4	12
2	67,206.3	9	604,860.3	37
3	12,268.8	6	73,612.8	4
4	32,507.4	5	162,537.0	10
5	47,072.8	10	470,728.0	29
6	3,063.2	10	30,632.0	2

= 1,547,088.5

The actual 1/4-sections sampled were chosen using uniformly distributed random numbers; these were chosen until each stratum received its proper allocation. For any sample to be accepted, it had to be at least 70 percent contained within the appropriate stratum. In addition, a number of samples equal to 20 percent of the optimum allocation were chosen in each stratum. These were enumerated in the order of their choice and used to replace samples that had to be rejected during the fieldwork.

Section 4

METHODS

Prior to the beginning of fieldwork and during the first field session, the criteria for rejecting random sample units were defined in consultation with the COAR and the project statistician. They include:

1. Steep Slopes: It was the intent of the Principal Investigator Archaeologist and the COAR that all random sample units that could be reached on foot should be included, even when some portions of the unit could not be walked safely along straight transects at 50 m intervals. For this reason an arbitrary percent slope was not established as the safe limit. Instead the team leader was instructed to determine in the field when a sample unit's terrain could not be traversed safely.

   Sample units were not rejected if there were traversible slopes, ledges or ridge tops that could be reached safely, even if part of the unit's terrain was too steep for safe walking.

2. Inaccessibility: A sample unit was rejected as inaccessible when it was found to be isolated by a substantial zone of unstable rock slides or precipitous slopes requiring rock climbing skills and/or equipment. Quadrats that could not be reached and inspected on foot in time for the field team to return to their vehicle or a field camp within nine hours were rejected and replaced by the next alternate sample unit.

3. Coverage: Sample units were rejected if greater than or equal to 70 percent were not within the stratum sampled.

4.1 LOCATION TECHNOLOGY

Compasses, color aerial photographs and USGS 7.5' topographic maps were used for orientation in the field. Although section corner markers are present in only a small portion of the project area, a total of 14 section and quarter section corner markers or mapped bench marks were found in the field in or near 12 sample unit boundaries. In order to improve the reliability of mapping quadrat boundaries and recording site locations within sample units, the sampling design provided for the orientation of each sample unit when possible so that an edge or corner was on or near a bench mark, at the confluence of major washes or near another prominent landform. Field team leaders used range finders (Ranging Opti-Meter 620), which can measure reliably distances up to 180 m (600 ft), to determine the distance of sites or quadrat corners from known points.

4.2 SAMPLE UNIT COVERAGE

Sample units were surveyed along approximately straight transects at 50 m intervals, oriented parallel to the ridge and drainage system. The only exceptions were portions of some sample units, which were too steep or otherwise unsafe for field crews to maintain straight transects. Such areas were crossed by the safest, most expeditious way feasible, to reach ridge tops, ledges, relatively level surfaces and potentially used caves or shelters.

4.3 COLLECTION STRATEGY

The collection of archaeological specimens was avoided except in the case of seven pottery sherds collected for comparison with analyzed assemblages at the Lost City Museum. Another exception was the collection of a small sample from a fossil Neotoma midden from Yellow Man Cave in Stratum 2 to confirm the field identification of pine needles (see above, Section 2.3).

4.4 SITE MARKING

Sites were not posted or marked in any way. Detailed directions to all sites are in the site records, and site locations are plotted on field maps and on site index maps in central record repositories.

4.5 RECORDS

Records of the survey include sample unit forms showing the location of the unit, kinds and numbers of sites recorded, location and orientation of transects, field crew, date, and time required for survey. Intermountain Antiquities Computer System (IMACS) site inventory forms were used to record site information. With the concurrence of the COAR, the BLM short cultural resource form was used to record sites of isolated lithic artifacts. In addition, all sites found during travel to and from sample units were also recorded on the short forms when time did not permit the collection of sufficient information for the IMACS form.

Color or black and white photographs were taken of each site except for some sites of isolated lithic artifacts. Sketch maps were made showing the relationship of artifacts and features to significant landforms in the immediate vicinity. Sketches or photographs were made of significant artifacts including projectile points, large pottery sherds, shaped stone tools and a sample of ground or battered rocks. All rock art panels were photographed and most were also sketched to scale.

Field observations were recorded on one-page forms, lined note paper and graph paper. These were transcribed later onto IMACS forms and each form was read and edited for accuracy by one or more of the original field crew and by the Co-Principal Investigator.

Completed IMACS forms and all original field notes are filed with the sample unit records in the Nevada State Museum. Copies of edited IMACS and Sample Unit records were submitted to the Las Vegas District Office, BLM, the University of Nevada, Las Vegas, Museum of Natural History; Nevada State Museum, Carson City and Las Vegas; and the Lost City Museum, Overton.

The small ceramic collection will be curated at the Nevada State Museum, Carson City, under terms of the curation agreement between the Museum and the BLM. The Neotoma midden sample from Yellow Man Cave has been submitted to the Las Vegas District Office for analysis by a wildlife biologist.

Section 5

RESULTS

5.1 COVERAGE OF THE PROJECT AREA

The location of all random sample units and the boundaries of strata are shown on Figure 5-1. In addition, the number of sample units and the percent coverage for each stratum are shown in Table 5-1. In general, sample units are well dispersed throughout the project area. Units in the smaller strata are less well dispersed, however. This is particularly true of Strata 3 and 6 which have only 4 and 2 sample units respectively; large parts of each stratum were not visited by field teams during the surveying of random sample units and we could not be sure that all major site types in the areas were represented in the units surveyed.

To compensate for this, a series of intuitive sample units were planned west of Meadow Valley Wash (Strata 4 and 6), north and west of Jakes Pockets (Stratum 3) and along the part of Meadow Valley Wash (Stratum 6) on the Rox 7.5' quadrangle. These are portions of the strata that were not sampled by random sample units. Approximately 5 percent of the intuitive sample or 200 acres were required for this.

Most of the intuitive sample units were deployed to increase the size of the inventory of significant site types, to look for representatives of rare site types, and to explore areas of expected high site density. Intuitive units were placed around those springs that were not within random sample units and intuitive units were dispersed along those parts of the Meadow Valley Wash that are within the project area. Several intuitive units were placed on saddles and divides between major drainages. Road junctions were inspected for historic sites. Maps and aerial photographs were used to determine the location of mining, railroad, ranching and roasting pit sites. The last site type was often mapped by the USGS as "ruins" and many are visible on the aerial photographs. Table 5-2 lists criteria used for selecting intuitive sample units.

The location of intuitive sample units is shown on Figure 5-2. Coverage by the combined intuitive and random samples (see Table 5-1) amounts to at least 6 percent of the heavily dissected northwest-facing piedmont (Stratum 4), 7 percent of the embayed mountains on the southwest part of the range (Stratum 3), 8 and 12 percent of the rest of the mountains (Strata 1 and 2 respectively), 12 percent of the rest of the piedmont (Stratum 5) and nearly 25 percent of the Meadow Valley Wash (Stratum 6).

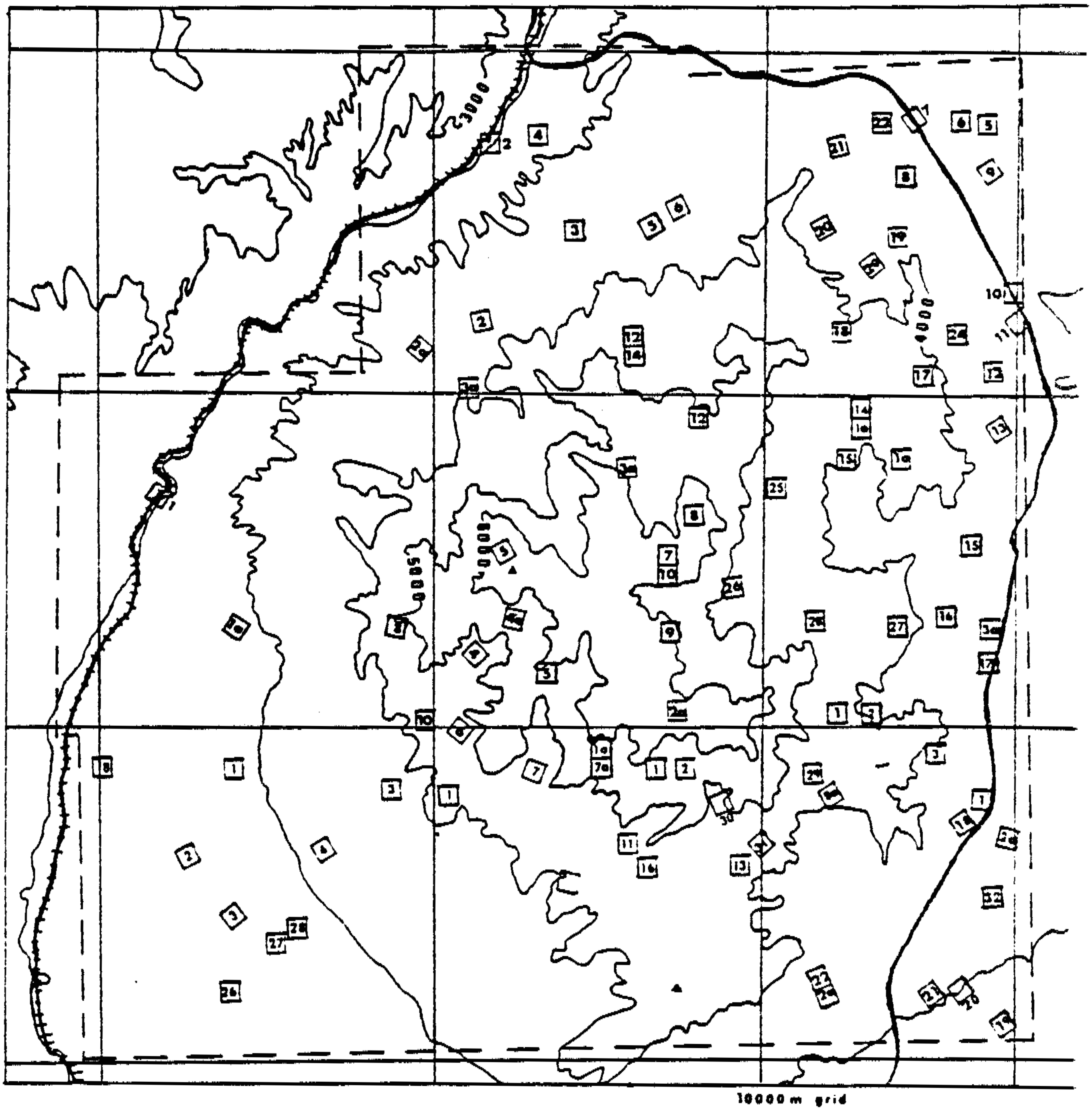


Figure 5-1. MAP OF THE PROJECT AREA SHOWING THE LOCATION OF ALL RANDOM SAMPLE UNITS

Note: Use overlay provided in pocket on inside of back cover to identify strata boundaries.

Table 5-1

COVERAGE OF PROJECT AREA

Stratum	Project Area Size Acres*	Stratified Random: Size Acres	Stratified Random: No. Units	Stratified Random: Row Percent	Intuitive: Size Acres	Intuitive: No. Units	Intuitive: Row Percent
1	25,590	1,920	12	7.5	215	3	1.7
2	67,206	5,920	37	8.8	2,059	35	3.3
3	12,269	640	4	5.2	340	7	0.4
4	32,507	1,600	10	4.9	79	3	0.2
5	47,073	4,640	4	9.9	622	15	1.2
6	3,363	320	2	9.5	420	6	15.4
All	188,008	15,040	94	8.0	3,735	70	2.0

*Acreage for strata was measured in the BLM office by consulting statisticians during sample development. An estimated mean error of 0.16 percent is indicated by the 300 acre difference between the sum of the acres in all strata and the total acreage for the project area as mapped by the USGS. The estimated total acreage is used here for calculating percent coverage of project area.

Table 5-2. CRITERIA FOR THE SELECTION OF INTUITIVE SAMPLE UNITS

Site Type	Criteria Used to Select Intuitive Sample Units
Roasting Pit	Washes with alluvial terraces greater than 10 mi wide, and offering proximity to limestone gravel; areas around mapped "ruins" or around roasting pits visible on aerial photos.
Roasting Pit, Shelter	Alluvial terraces below limestone cliffs or in deep straight-sided washes with "caliche" shelters.
Shelters, Caves	Limestone cliffs, seen during travel in the project area or from inspection of maps and aerial photos.
Rock Alignment	Edges of broad terraces extending into Meadow Valley Wash.
Historic	Intersection of major dirt roads or jeep trails with the Carp-Elgin road; mapped mines or mining claims; named localities, such as the summit of the Carp-Elgin road, railroad sidings or stations; mapped corrals; springs.

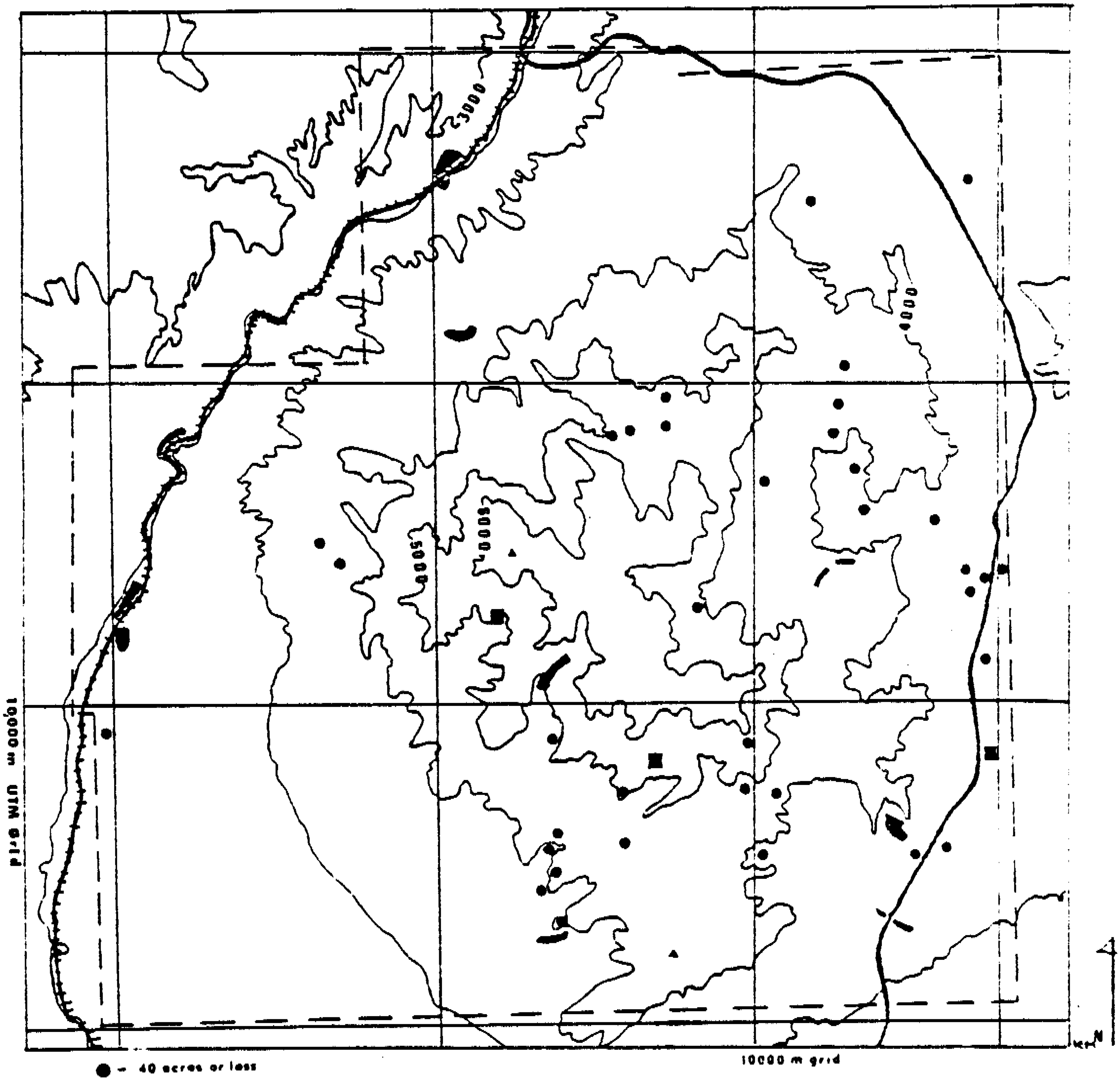


Figure 5-2. MAP OF THE PROJECT AREA SHOWING THE LOCATION OF ALL INTUITIVE SAMPLE UNITS

5.2 THE ARCHAEOLOGICAL SITE INVENTORY

Before completion of this field study there were 29 known archaeological sites in the Mormon Mountains, 12 recorded during in-house BLM or contract-supported surveys of areas subject to impact by construction projects or seismic exploration. Others (17) were first recorded or field checked by a crew from the Archaeological Research Center, University of Nevada, Las Vegas, during an archaeological survey of two areas near Hackberry Spring (Ellis et al. 1982b).

During our field work 117 sites were recorded in random sample units (including 6 that had been previously recorded) and 98 in intuitive sample units. An additional 24 sites were found during travel between sample units. Site numbers were assigned and records compiled for the following kinds or combinations of cultural features or artifacts:

1. Sites of isolated occurrences of lithic artifacts, very small clusters of fewer than 10 specimens in an area of less than 15 m^2 (49 ft^2), or small isolated features such as hearths;

2. Larger clusters of artifacts and/or cultural features such as roasting pits, rock art or rock alignments;

3. Shelters or caves that exhibit smoke-blackened interiors, or contain artifacts, calcined bone or rocks and or charcoal stained deposits;

4. Combinations of caves or shelters and rock art or roasting pits (usually within 100 m or 330 ft);

5. Structures, trash scatters or earth surface modification attributable to a post-White contact and pre-1930 context.

Long linear historic features such as the Union Pacific Railroad (formerly the San Pedro, Los Angeles and Salt Lake Railroad [SP, LA and SLRR]), the Meadow Valley Wash road and the Carp-Elgin road are clearly significant historic sites. They have not, however, been assigned site inventory numbers and are not treated here as, themselves, part of the site inventory. (They are discussed by Muñoz in the brief historic overview of the Mormon Mountains project area, Appendix II). Here they are referred to by their familiar local names and regarded as part of the context of individual historic sites (structural remains, mines, or stock-raising features) which are inventoried individually. In two areas several discrete concentrations of structural features, trash scatters, mine shafts or prospects and claim posts are linked by primitive roads or vehicle tracks. Historic archaeological remains in each of these areas are recorded as a single site even though some of the features are over 200 m (660 ft) apart and at locations that are not intervisible.

Finally, land survey markers and mining claim posts found during our reconnaissance have been marked on field maps, with the dates, but not otherwise recorded.

There are now 262 recorded archaeological sites in the project area, of which 233 were recorded during this study. Cultural features and artifacts are attributable to various patterns of land use during at least the past two thousand years; some may be older.

5.3 PREHISTORIC SITES:

Six site types were defined for the Mormon Mountain area on the basis of apparently patterned co-occurrences of specific feature and artifact types. These are:

1. Caves or Shelters;
2. Caves or Shelters with Roasting Pits;
3. Caves or Shelters with Rock Art on interior walls;
4. Roasting Pit Sites single occurrences or clusters of roasting pits, some of which have other features such as hearths or rock alignments nearby;
5. Artifact Scatters flaked stone, ground stone and/or ceramics with varying artifact density, including some large sites (over 1,000 m^2 or 10,800 ft^2) where only from 10 to 20 artifacts were observed by the field team;[3]
6. Isolated Artifacts or Features: single occurrences or small clusters of artifacts or single occurrences of small features such as hearths or rock-lined pits; and
7. Rock Alignments: linear arrangements of cobbles or boulders on desert pavement, some of which have small scatters of flaked and ground stone artifacts associated.

5.4 HISTORIC SITES

Evidence of human presence after White contact includes various combinations of structural remains, artifacts and land disturbance attributable to mining, livestock raising, local and regional transportation, and government land management. Machine made artifacts were found at 11 prehistoric sites. Some of these associations are apparently fortuitous: for example, relatively recent beverage or food cans in or near caves, shelters and roasting pits. Others, including a screen, were apparently abandoned after digging holes in the site. One roasting pit site and two shelter-roasting pit sites had scatters of rusted food and tobacco tins and other machine-made metal artifacts that may pre-date the turn of the century.

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[3] These apparently isolated occurrences of artifacts were grouped under a single site number to avoid the proliferation of site numbers and to show the presence of a very low but measurable artifact density in the area.

For purposes of the preliminary tabulation of site types by stratum (Tables 5-3 and 5-4) metal and glass trash scatters in prehistoric sites are not included in the Historic Site type.

5.5 DISTRIBUTION OF KNOWN SITES IN THE MORMON MOUNTAINS

The distribution of known archaeological sites by stratum in the Mormon Mountains is shown on Tables 5-3 and 5-4 for the random and intuitive samples. Nearly half the sites recorded during the random sample are in the lower mountains (Stratum 2) with a site density of nearly 1 site per 100 acres. Only the very small Strata 3 (embayed mountains) and 6 (Meadow Valley Wash) have higher site densities. In addition to its relatively high site density, Stratum 2 exhibits the greatest site type variability of all parts of the project area, and Strata 1 (the high mountains) and 6 show the least variability.

Roasting pit sites account for nearly 40 percent of all sites recorded in the random sample and occur in all strata except for Meadow Valley Wash. Isolated artifacts or features comprise another 30 percent of the sites from random units and they occur in all strata, although with varying frequency. In contrast, a relatively rare site type, shelters with rock art on walls, was represented by only 1 site in Stratum 2. Finally, 1 site type, rock alignments as defined in Section 5.2 above, was found only in the Stratum 6 sample.

In general the intuitive sample (Table 5-4) yielded a site density nearly three times as large as the random sample. This attests to the success of the random sample survey in identifying the characteristics of areas of high site density. The intuitive sample also yielded five additional shelters with rock art, four in Stratum 2 and one in Stratum 3, as well as two shelters with design-incised stones; five additional rock alignment sites were also found, all in Stratum 6. The intuitive sample of Meadow Valley Wash also yielded sites representing three types (lithic scatters, shelters and historic sites) not present in the two random units. Site types were also added to the inventory of three other strata: an open lithic scatter in Stratum 1 (the high mountains), and shelters in Strata 4 and 5 (the piedmont strata).

Over 60 percent of the shelters and caves and slightly over half of the open roasting pit sites were recorded during the intuitive sampling of the project area. This phase of the field work yielded approximately 40 percent of the historic sites and the open artifact scatters, also a greater site density than present in the random sample. In contrast, less than 25 percent of the sites of isolated artifacts or features were found in intuitive units. The environmental variables that appear to be most strongly associated with the site distribution in the Mormon Mountains will be discussed below.

Table 5-5 shows the previously recorded sites in the Mormon Mountains, except for six sites in three of the random sample units (Table 5-3 above). These were re-visited by our field teams when they surveyed the units. The table also shows the distribution of sites recorded during this field work between sample units. The previously recorded and out-of-unit sites increase

Table 5-3. DISTRIBUTION OF KNOWN ARCHAEOLOGICAL SITES BY STRATUM: RANDOM SAMPLES

	1		2		3		4		5		6		All	
Type Site	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Col %
Shelter:	1	12.5	6	75.0	1	12.5	0	-	0	-	0	-	8	6.8
Shelter with roasting pit:	0	-	1	20.0	1	20.0	1	20.0	2	40.0	0	-	5	4.3
Shelter with rock art on walls:	0	-	1	100.0	0	-	0	-	0	-	0	-	1	0.9
Open, roasting pit:	7	14.9	28	59.6	1	2.1	2	4.3	9	19.2	0	-	47	40.2
Open, artifact scatter:	0	-	6	85.7	0	-	1	14.3	0	-	0	-	7	6.0
Open, isolated artifact:	2	5.7	13	37.1	3	8.6	1	2.9	14	40.0	2	5.7	35	29.9
Rock Alignments:	0	-	0	-	0	-	0	-	0	-	3	100.0	3	2.6
Historic site (does not include trash scatters with roasting pits):	3	27.3	2	18.2	2	18.2	0	-	4	36.4	0	-	11	9.4
All sites sampled:	13	11.1	57	48.7	8	6.8	6	4.3	29	24.8	5	4.3	117	100.0
Acreage in strata	1,920		5,920		640		1,600		4,640		320		15,040	
Site density:	0.68		0.96		1.25		0.11		0.63		1.56		0.78	
Number of site types in samples:	4		7		5		4		4		2		8	

Table 5-4. DISTRIBUTION OF KNOWN ARCHAEOLOGICAL SITES BY STRATUM: INTUITIVE SAMPLES

Type Site	1		2		3		4		5		6		All	
	Count	/Row %	Count	/Row %	Count	/Row %	Count	/Row %	Count	/Row %	Count	/Row %	Count	/Col %
Shelters:	3	16.7	10	55.6	1	5.6	1	5.6	2	1.11	1	5.6	18	18.4
Shelters with roasting pits:	0	-	1	25.0	0	-	0	-	3	75.0	0	-	4	4.1
Shelters with rock art on walls:	0	-	4*	80.0	1*	20.0	0	-	0	-	0	-	5	5.1
Open, roasting pits:	2	4.4	34	75.6	4	8.9	0	-	4	11.1	0	-	44	44.9
Open, artifact scatters:	1	20.0	2	40.0	0	-	1	20.0	0	-	1	20.0	5	5.1
Open, isolated artifact feature:	0	-	7	100.0	0	-	0	-	0	-	0	-	7	7.1
Open, rock alignment:	0	-	0	-	0	-	0	-	0	-	5	100.0	5	5.1
Historic site (not including trash scatters inroasting pits:	2	20.0	3	30.0	0	-	0	-	1	10.0	4	40.0	10	10.2
All Sites:	8	8.2	61	62.2	6	6.1	2	2.0	10	10.2	11	11.2	98	100.0
Acreage sampled in strata:	215		2,059		340		79		622		420		3,735	
Site density (count per 100 acres):	3.72		2.96		1.76		2.53		1.61		2.61		2.62	
Number of site types in sample:	4		7		3		2		4		4		8	

*Includes one shelter in Stratum 2 and one in Stratum 3 with rock art and roasting pits.

Table 5-5. SITES RECORDED BETWEEN SAMPLE UNITS AND PREVIOUSLY RECORDED SITES*

Type Site	1	2	3	4	5	6	All
Shelters:	3	3	1	1	0	0	8
Shelters with roasting pits:	0	1	0	0	2	0	3
Shelter with rock art on walls:	0	0	0	0	0	0	0
Open, roasting pits:	5	9	4	0	4	0	22
Open, lithic scatters:	0	0	0	5	0	0	5
Open, isolated artifact feature:	2	0	0	0	1	0	3
Open, rock alignment:	0	0	0	0	0	0	0
Historic site (not including trash scatters inroasting pits:	0	0	0	0	1	1	2
All Sites:	10	13	5	6	8	1	43

*Does not include six previously recorded sites in 3 random sample units and four previously recorded sites which location is questionable the number of sites known for all strata. They significantly augment the number of recorded open roasting pit sites and shelters or caves, but include few other site types. This is partly attributable to the focus on roasting pits in one of the earlier field studies (Ellis et al. 1982b), but is also probably due to the greater visibility of shelters and roasting pits compared to other site types. Many roasting pits are located along the primitive roads and jeep trails which follow washes in the project area and were thus encountered during travel between sample units. Caves and overhangs are often visible from a large distance and the project field teams occasionally made detours to inspect some of these on their way to sample units. An isolated flaked stone tool and a small historic site (a General Land Office 1934 survey camp) near sample units were also recorded during this field season. Previously recorded sites include one isolated feature (a rock wall tentatively identified as a hunting blind), four lithic scatters, another isolated feature identified as a prehistoric trail, and one historic site in addition to a shelter with rock art, two shelters with roasting pits, two other shelters with associated artifacts and/or smoke-blackened interiors, but no rock art or roasting pits, and 14 open roasting pit sites. The rock art site and five of the roasting pit sites are in three random sample units near Hackberry Spring and are included in Table 5-3 instead of Table 5-5.

5.5.1 Actual and Predicted Site Distribution

As shown above (Tables 5-3 through 5-5), all site types that have been recorded in the Mormon Mountains were found in the stratified random sample, although not in all strata where the site types were found in the intuitive sample or otherwise recorded. As discussed above, the most striking instance of this is the lack of historic sites in the two random sample units in the Meadow Valley Wash. Three historic sites were recorded during the intuitive sampling and one was previously recorded, so that historic sites represent over 20 percent of the Meadow Valley Wash site inventory to date. In similar instances in other strata, only one or two sites have been subsequently found suggesting that the types not represented in the random sample are rare in those strata.

It would appear that except for Stratum 6 (Meadow Valley Wash), the stratified random sample reliably shows the distribution of sites in the project area.

As shown in Section 3.4 (above), the expected site distribution was used in the allocation of the sample units to strata. Predicted and actual site distribution is shown in Table 5-6. Data from random sample units are used for Strata 1 through 5, but the combined intuitive and random sample data are used for Stratum 6, in order to correct the apparent sampling error.

The predictions of presence and relative frequency of artifact and site types in the Mormon Mountains shown in Table 5-6 were largely based on tacit knowledge of regional archaeological site locations. Extensive published data from similar terrain are lacking and, moreover, some of the site records and the report of Richard Brooks' recent survey and testing project near Hackberry Spring (Ellis et al. 1982b) became available only after the sampling design was completed. In retrospect, however, it is clear that the

Table 5-6. PREDICTED SITE DISTRIBUTION AND ACTUAL DISTRIBUTION, BY STRATUM

Type Site	1		2		3		4		5		6*		All	
	Predicted/ (Actual)		Predicted/ (Actual)		Predicted/ (Actual)		Predicted/ (Actual)		Predicted/ (Actual)		Predicted/ Actual)		Predicted/ (Actual	
Caves, Shelters:	1	(1)	1	(2)	1	(1)	1	(1)	1	(1)	1	(1)*	6	(7)
Rock Art	1	(0)	1	(1)	1	(1)*	1	(0)	1	(0)	1	(0)	6	(2)
Lithic Scatters	2	(0)	2	(2)	2	(0)	1	(1)	1	(0)	1	(1)*	9	(4)
Isolates	2	(1)	2	(2)	2	(2)	2	(0)	2	(2)	2	(1)	12	(8)
Roasting Pits	0	(1)	1	(2)	0	(0)	0	(1)	2	(2)	0	(0)	3	(6)
Ceramics	1	(1)	1	(1)	0	(0)	0	(0)	2	(1)	2	(0)	6	(3)
Pueblos	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	1	(0)**	1	(0)
Historic Sites	1	(1)	1	(1)	0	(1)	0	(0)	1	(1)	2	(2)*	5	(6)
	8	(5)	9	(11)	6	(5)	5	(3)	10	(7)	10	(5)	48	(36)

* Takes into consideration the results of intuitive sample

** Predicted Puebloan sites are actually equivalent here to the rock alignment sites (see discussion)

0 = Absent or nearly so
1 = Present
2 = Abundant

distribution of roasting pits should have been more accurately predicted on the basis of site locations mapped by the USGS as "ruins" and the approximately 70 roasting pit sites clearly visible on aerial photographs, both known to the Co-Principal Investigator. The distribution of other site types was less obvious. Isolated artifacts or features are the most frequently occurring sites in many regions, as are open artifact scatters. Both site types, but particularly the former, are less abundant than was predicted for the Mormon Mountains. Rock art sites were predicted to be present but not abundant in all strata on the basis of a mapped location high in the lower mountains near the Stratum 1/2 boundary, as well as known sites in shelters and on rock outcrops in various parts of southern Nevada. Rock art was found predominantly in Stratum 2.

A high site variability and high site density were predicted for Meadow Valley Wash. It was, in fact, the low variability exhibited by the random sample units in Stratum 6 that caused us to plan additional intuitive sample units throughout the stratum. The presence of water, a natural passageway through rugged terrain and proximity to the lower Moapa Valley were the basis for the density and variability expectations. Moreover, one of the rock alignment sites we recorded had been reported by the COAR, but not as yet systematically examined and recorded (Rolf, personal communication). Because horticulture might have been possible in parts of the Meadow Valley Wash, it seemed reasonable that a Puebloan outpost might be present in Stratum 6. Initial expectations were not borne out. Even when the results of a nearly 25 percent intuitive sample are included, the site inventory for Stratum 6 is neither as dense nor as variable as predicted. No Puebloan ceramics or structures and no rock art were found within the project area, although both ceramics and rock art are present in Meadow Valley Wash both north and south of the Mormon Mountains.

In spite of the noted discrepancies between expected and actual site distribution, approximately 65 percent of the predictions were reasonably reliable. Moreover, environmental data were collected that can enhance the value of the random sample survey data as a cultural resource management tool.

5.5.2 Estimating Site Density and Site Type Variability in the Mormon Mountains

From the previous discussion it can be seen that known sites and site types are not uniformly distributed across the landscape in the Mormon Mountains. If this apparent variability in site type and density can be relied upon to resemble the actual site distribution in the project area, it would be a great aid in making and implementing cultural resource management policy. Data from the stratified random sample were, therefore, analyzed to find what kinds of variability can be expected to occur among strata and what environmental variables other than those that define stratum boundaries are frequently associated with sites.

Meadow Valley Wash: Some clear patterns of site distribution emerged from the Mormon Mountain Class II survey, particularly in respect to the distinctive site distribution in Meadow Valley Wash. This stratum (6) differs strikingly from all other strata in the distribution of two site types: roasting pit sites, which occur in all strata except Meadow Valley Wash, and rock alignment sites, which occur only in Meadow Valley Wash (Table 5-7).

Table 5-7.
DISTRIBUTION OF ROASTING PITS AND ROCK ALIGNMENTS IN RESPECT TO MEADOW VALLEY WASH

Site Type	Mountains, Piedmont	Meadow Valley Wash
Roasting pits	present	absent
Rock alignments	absent	present

Other differences in distribution are apparent. Because of the need to resort to data from intuitively selected sample units (see Section 5.1) to flesh out the site inventory for Meadow Valley Wash, the use of statistical tests dependent upon randomness is clearly not indicated. Table 5-8 shows the distribution of four site types between the combined Mountain and Piedmont strata and the Meadow Valley Wash. Differences are striking and no further confirmation is really necessary.

Table 5-8. SITE DISTRIBUTION IN MOUNTAIN AND PIEDMONT STRATA COMPARED TO THE MEADOW VALLEY WASH

Site Type	Mountains Piedmont Count/Col %		Meadow Valley Wash Count/Col %		Total Area Count/Col %	
Shelters, caves	14	20.9	1	14.3	15	20.3
Artifact scatters	7	10.5	1	14.3	8	10.8
Isolated artifacts, features	35	52.2	2	28.6	37	50.0
Historic	11	16.4	3	42.9	14	18.9
Totals & Row Percents	67	90.5	7	9.5	74	100.0

NOTE: Data from mountain and piedmont strata are from random sample; data from Meadow Valley Wash are from grouped random and intuitive samples.

For Meadow Valley Wash, the most frequently occurring of the four site types are historic sites and isolated artifacts or features. In the rest of the project area two prehistoric site types, isolates and shelters or caves, occur most frequently. Table 5-9 displays the frequency of prehistoric and historic sites.

Table 5-9. FREQUENCY OF PREHISTORIC AND HISTORIC SITES IN MEADOW VALLEY WASH COMPARED TO MOUNTAIN AND PIEDMONT STRATA

Site Type	Mountains Piedmont Count	Mountains Piedmont Col %	Meadow Valley Wash Count	Meadow Valley Wash Col %	Total Area Count	Total Area Col %
Prehistoric	56	83.6	4	57.1	50	81.1
Historic	11	16.4	3	42.9	14	18.9
Total	67	90.5	7	9.5	74	100.0

NOTE: Data from mountain and piedmont strata are from random sample; data from Meadow Valley Wash are from grouped random and intuitive samples.

Mountain and Piedmont Strata: Differences among the mountain and piedmont strata are less obvious than the differences observed between Meadow Valley Wash and the rest of the project area. Statistical analysis of the stratified random sample, however, has shown significant variation. Before presenting the results of this analysis, it is necessary to consider the relationship between the archaeological site distribution in the strata and the samples from which we hope to learn about that site distribution.

As discussed in Section 3 above, the project area was stratified in an attempt to reduce the within-strata variability of certain environmental characteristics, primarily elevation and topography with associated variation in annual precipitation and vegetation. These factors are assumed to be associated with variation in archaeological site distribution. The amount and kind of archaeological variability expected to occur within and among strata were then estimated ("predicted"). Size of the stratum and the estimated variability were the factors considered in the allocation of the number of sample units.

The assumption implicitly underlying such a sampling design is that by sampling tracts of land we are also sampling archaeological site distribution. This is true, however, only to the extent that sites are either randomly or uniformly distributed within strata. (This point has been raised by Hall (1981) and discussed by Bettinger (1981).) In turn, this is true only if all environmental variables significantly associated with site distribution are randomly or uniformly distributed within strata. This has rarely been found to be the case. The success of the Mormon Mountain intuitive survey measured by the site density in intuitive units nearly three times as great as the site density in randomly selected units shows that we can select those parts of the landscape where sites or certain types of sites are most likely to occur. If site distribution were random in the strata we could not intuitively select areas of higher site density. For another illustration, Thomas and Bettinger found polythetic sets of environmental variables such as slope, proximity to ephemeral streams or springs and presence of pinyon trees to accurately predict a certain class of site in the Monitor Valley (Thomas and

Bettinger 1976:272). These are the kinds of variables that presumably are not distributed randomly and that, in fact, with the exception of pinyon trees, occur in more than one stratum or cut across stratum boundaries. Associated site types cannot be assumed to occur randomly within strata, where the predictive environmental variables are not distributed randomly.

Lacking specific confirmation for the Mormon Mountains, the assumption of random or uniform site distribution within strata cannot be justified. The conceptual leap from sampling the landscape to formulating site distribution expectations from raw site and site type frequencies is thus also unjustified. The appropriate analytic unit is, therefore, the sample unit not the site. This approach is discussed by Coombs (1979:76-77), who justified its use on the basis of its ability to show variability in site density.

Site type and frequency data are shown in Table 5-11 for each random sample unit in the five mountain and piedmont strata. From these data, rather than from site types and frequencies tabulated by stratum as in Tables 5-3 through 5-5, we will seek answers to questions raised at the onset of our study:

- Is there significant variability in site distribution in the Mormon Mountains?
- If so, what can we learn from this?
- How is it useful to cultural resource managers?

The data presented in Table 5-11 were analyzed using the Kruskall-Wallis one-way analysis of variance (Siegel 1956:184-193) on an Apple II personal computer and a Basic program (Dynacomp 1982).

Statistically significant variability was found in both site type and site density distribution between the grouped mountain and the grouped piedmont strata (Table 5-11). The null hypothesis that both samples come from populations having the same distribution is rejected in both instances. Neither the analysis of the three mountain nor the two piedmont strata showed significant differences in respect to site type or site density distribution. In other words, the samples from three mountain strata sample similar populations as do samples from the two piedmont strata. This justifies their grouping into one mountain stratum and one piedmont stratum insofar as the distribution patterns we are seeking here. In fact, by grouping these strata the pattern emerges more clearly. This is not to deny that other site distribution information may be obscured by grouping the strata. In fact, the examination of specific environmental variables associated with each of the recorded site types might suggest site distribution questions for which the strata as originally defined here are most appropriate.

Having shown that the grouped mountain and grouped piedmont strata differ significantly in respect to the internal variability of site density and types, it remains to determine whether or not certain site types can be expected to occur with relatively greater frequency in one stratum.

Table 5-10. SITE TYPE AND FREQUENCY

Mountains	Shelters Caves	Caves Pits	Roasting Pits	Scatters Isolates'	Historic Sites	Frequency: Site Types	Frequency: Sites
1-1	-	-	P	-	P	2	2
2	-	-	-	P	P	2	2
3	-	-	P_3*	-	-	1	3
5	-	-	-	-	-	0	0
7	-	-	-	-	-	0	0
8	-	-	-	-	-	0	0
9	-	-	-	-	-	0	0
10	-	-	-	-	-	0	0
12	-	-	-	-	-	0	0
2a	-	-	-	-	P	1	1
3a	-	-	-	-	-	0	0
4a	P	-	P_3	P	-	3	5
2-1	-	-	-	-	-	0	0
2	-	-	P	P_2	-	2	3
3	-	-	P_2	-	-	1	2
4	-	-	P_3	P	-	2	4
5	-	-	P	P	-	2	2
6	-	-	-	-	-	0	0
7	-	-	P_2	P	-	2	3
8	-	-	-	-	-	0	0
10	-	-	-	-	-	0	0
11	-	-	P	-	-	1	1
12	-	-	P	-	-	1	1
13	-	-	-	P	-	1	1
14	P_2	-	P	P	P	4	5
15	-	-	P	P	-	2	2
16	-	-	o	-	-	1	1
17	-	-	-	-	-	0	0
18	-	-	P_3	-	-	1	3
19	-	-	-	P	-	1	1
20	-	-	P	P	-	2	2
21	-	-	-	-	-	0	0
22	-	-	-	P_2	P	2	3
24	-	-	-	-	-	0	0
25	-	-	-	P	-	1	1
26	-	-	P	P_3	-	2	4
27	P_2	-	-	-	-	1	2
28	-	-	-	-	-	0	0
29	-	-	P	-	-	1	1
30	-	-	-	P	-	1	1
31	P	1	P_5	P_2	-	3	8
32	-	-	-	-	-	0	0
2-1a	-	-	-	-	-	0	0
2a	-	-	-	-	-	0	0
3a	P	P	-	-	-	2	2
5a	-	-	-	-	-	0	0
6a	-	-	P_2	-	-	1	2
7a	P	-	P	-	-	2	2
8a	-	-	P	P	-	2	2
3-1	-	-	-	-	-	0	0
2	P	-	-	P	-	2	2
3	-	-	-	-	P_2	1	2
1a	-	P	P	P_2	-	3	4
Totals	7 (9 sites)	2	22 (37 sites)	19 (25 sites)	6 (7 sites)	53 (73 sites)	

*Subscript = number of sites of that type present in unit where n 1
P = present
- = absent

Table 5-10. SITE TYPE AND FREQUENCY

Piedmont	Shelters Caves	Caves Pits	Roasting Pits	Scatters Isolates'	Historic Sites	Frequency Site Types	Frequency Sites
4-1	-	-	-	-	-	0	0
2	-	-	-	-	-	0	0
3	-	-	-	-	-	0	0
4	-	-	-	-	-	0	0
5	-	P	P	-	-	2	2
6	-	-	P	-	-	1	1
8	-	-	-	P	-	1	1
9	-	-	-	P	-	1	1
1a	-	-	-	-	-	0	0
2a	-	-	-	-	-	0	0
5-1	-	-	-	P	-	1	1
2	-	-	-	-	-	0	0
3	-	-	-	-	-	0	0
4	-	-	-	P	-	1	1
5	-	-	-	-	P	1	1
6	-	-	-	-	-	0	0
7	-	-	-	-	-	0	0
8	-	-	-	P	-	1	1
9	-	-	-	P_3	-	1	3
10	-	-	-	-	P	1	1
11	-	-	-	-	-	0	0
12	-	-	P	-	-	1	1
13	-	-	P	-	-	1	1
14	-	-	-	P	-	1	1
15	-	-	-	P	-	1	1
16	-	-	-	-	-	0	0
17	-	P	-	P_3	P	3	5
18	-	P	-	-	-	1	1
19	-	-	-	-	-	0	0
20	-	-	-	-	-	0	0
21	-	-	-	-	-	0	0
22	-	-	P	-	-	1	1
26	-	-	-	P	-	1	1
27	-	-	-	-	-	0	0
28	-	-	-	-	-	0	0
29	-	-	P_6	P_2	P	3	9
1a	-	-	-	-	-	0	0
2a	-	-	-	-	-	0	0
Totals Number Units	0	3	6	11	4	N=39 Total Sites 34	

*Subscript = number of sites of that type present in unit where n 1
P = present
- = absent

Table 5-11. RESULTS OF KRUSKALL-WALLIS ONE-WAY ANALYSIS OF VARIANCE

SITE TYPE VARIABILITY

Run 1

Samples: Mountain Strata 1, 2 and 3
Number of observations = 53
Sample 1 = 12 Ranked sums = 265.5
Sample 2 = 37 Ranked sums = 1033.5
Sample 3 = 4 Ranked sums = 132.0
d.f. = 2 Alpha = .05
H (corrected for ties) = 2.137
Results: Fail to reject H_o

Run 2

Samples: Piedmont Strata 4 and 5
Number of observations = 39
Sample 1 = 10 Ranked sums = 185.5
Sample 2 = 29 Ranked sums = 594.5
d.f. = 1 Alpha = .05
H (corrected for ties) = 2.731
Results: Fail to reject H_o

Run 3

Samples: Grouped mountain and grouped piedmont strata
Number of observations = 92
Sample 1 = 53 Ranked sums = 2715.0
Sample 2 = 39 Ranked sums = 1563.0
d.f. = 1 Alpha = .05
H (corrected for ties) = 4.476
Results: Reject H_o

SITE DENSITY

Run 1

Samples: Mountain Strata 1, 2 and 3
Number of observations = 53
Sample 1 = 12 Ranked sums = 267.0
Sample 2 = 37 Ranked sums = 1032.5
Sample 3 = 4 Ranked sums = 131.5
d.f. = 2 Alpha = .05
H (corrected for ties) = 1.989
Results: Fail to reject H_o

Run 2

Samples: Piedmont Strata 4 and 5
Number of observations = 39
Sample 1 = 10 Ranked sums = 183.0
Sample 2 = 29 Ranked sums = 597.0
d.f. = 1 Alpha = .05
H (corrected for ties) = 0.370
Results: Fail to reject H_o

Run 3

Samples: Grouped mountain and grouped piedmont strata
Number of observations = 92
Sample 1 = 53 Ranked sums = 2746.5
Sample 2 = 39 Ranked sums = 1531.5
d.f. = 1 Alpha = .05
H (corrected for ties) = 5.539
Results: Reject H_o

A contingency table was made showing the number of units in each stratum in which each site type occurs (Table 5-12). The null hypothesis that distribution is random throughout the project area could not be rejected on the basis of chi square distribution as shown in the table. That is, the difference apparent from inspecting the tabulated frequencies of each site type in the random sample from each stratum (Table 5-3 above) was not reflected by the results of analyzing the frequency of units in which each site type occurs. It would appear that the strata differ in frequency of site types within sample units but not in the frequency with which specific site types occur over the landscape. The greater site density in the mountains shown in Table 5-11, for example, apparently accounts for the greater frequency of roasting pits found in the mountain strata.

Table 5-12. DISTRIBUTION AND FREQUENCY OF SAMPLE UNITS CONTAINING ONE OR MORE OF THE MORMON MOUNTAIN SITE TYPES

Site Types/Strata	Mountains		Piedmont		Totals
	O	E	O	E	
Shelters, caves*	9	8.4	3	3.6	12
Roasting pit sites	22	19.6	6	8.4	28
Scatters, isolates	19	21.0	11	9.0	30
Historic	6	7.0	4	3.0	10
Totals	56		24		77

*Includes caves and shelters with rock art and/or roasting pits
d.o.f. = 3
$x^2 = 2.234$
Fails to reject H_o

To test this, we compared the distribution of tracts with no sites, tracts with only one site and tracts with more than one site. Here a significant difference between the mountains and piedmont emerged. Mountain sample units with sites exhibit a strong tendency to have two or more sites in contrast to the piedmont where sample units with sites usually had only one each (Table 5-13). If there are likely to be two or more roasting pit sites within 8 to 10 km (5 to 6 mi) in the mountains in those locations where roasting pits are likely to occur and if there is likely to be only one roasting pit site per 8 to 10 km (5 to 6 mi; the maximum distance between sites in one of our 160-acre quadrats), there will be a higher site density for roasting pits in the mountains than on the piedmont. In other words, there are apparently the same relative frequency of potential roasting pit locations in both strata, but in the mountains there are likely to be more sites in those places than on the piedmont.

Table 5-13. FREQUENCY AND DISTRIBUTION OF SAMPLE UNITS
SAMPLE UNITS YIELDING NO SITES, 1 SITE OR GREATER THAN 1 SITE

Site Types/Strata	Mountains		Piedmont		Totals
	O	E	O	E	
Units with no sites	20	23.043	20	16.957	43
Units with 1 site	9	13.826	15	10.174	22
Units with greater than	24	16.13	4	11.87	27
Totals	53		39		92

*Includes caves and shelters with rock art and/or roasting pits
d.o.f. = 2
Alpha = .05
x^2 = 13.979
Reject H_o

In order to determine what environmental variables other than those used to define strata are associated with site distribution, it is necessary to examine the site inventory records and to look at the distribution of quadrats on the map. It has been observed previously that roasting pits occur on ephemeral stream terraces usually near agave patches (cf. Ellis et al. 1982b:55). This finding was confirmed intuitively during the Mormon Mountain Class II survey. We were able to select potential roasting pit locations with a high degree of accuracy. Certain differences in the distribution of roasting pit sites between mountain and piedmont zones emerged. Using the Fisher Exact Probability test with the Tocher ratio (Siegel 1956:110) we found significant difference between the mountains and piedmont in respect to the association of shelters with roasting pits (Table 5-14). This phenomenon has been observed in other areas (Ellis et al. 1982b:56). Specific distribution information for other site types may be found when Mormon Mountain site data are available at IMACS for an intensive computer-assisted search.

Table 5-14. THE SIGNIFICANCE OF ASSOCIATION OF SHELTERS AND ROASTING PITS ON THE PIEDMONT

Site Types/Strata	Mountains	Piedmont	Totals
Shelters	7	0	7
Shelters with roasting pits	2	3	5
Totals	9	3	12

Fisher - (Tocher Ratio) Exact Probability
Probabilty of this case alone .045
Tocher ratio = 1.1
Random number = .5518
Reject H_o

Meanwhile, the mapped locations of high site density units offer distribution information which may be useful to the BLM as well as to Great Basin archaeologists. Inspection of the project maps shows that high site density units in the mountains cluster within 3 km (approximately 2 mi) of the known springs on the same side of major divides (steep enough to impede foot traffic) or along major drainages. Within 3 km (2 mi) of springs, tracts without sites occur only across major divides. Elsewhere tracts without sites occur at distances greater than 1 km from major washes (i.e., washes with alluvial terraces approximately 10 km (6 mi) wide or greater). The significance of the distribution of sites is shown in Table 5-15.

Table 5-15. THE SIGNIFICANCE OF DISTRIBUTION OF SITES

	Tracts With No Sites		Tracts With 1 Site		Tracts With 1 Site		Totals
	O	E	O	E	O	E	
Tracts within 3 km and on same side of divides as spring, or along major washes	0	6.415	6	2.887	11	7.698	17
Tracts within 3 km and on opposite side of divides from spring	5	2.642	0	1.189	2	3.17	7
Tracts greater than 3 km from spring, not on major washes	15	10.943	3	4.925	11	13.132	29
Totals	20		9		24		53

d.f. = 4
Alpha = .01*
x^2 = 17.517
Reject H_0

*A high significance level set because data do not meet continuity requirements.

The analysis of the Mormon Mountain Class II survey data has not been exhaustive, but it has provided some information about the site distribution that should be useful to cultural resource managers when decisions must be made regarding land-uses that adversely affect archaeological sites. They are as likely to find site-free tracts of land in the mountains as on the piedmont, particularly if they seek such tracts across major divides from the springs. When they consider land-uses in the mountains they are advised to avoid those high site probability areas because site density is much greater than in similar areas on the piedmont. Combined with the criteria used during the

Class II Survey to select intuitive units (see Section 5.1 and Table 5-2), this becomes a useful management tool. Data were collected during the project and curated in a way that will permit more detailed analysis. Because this could potentially permit more reliable decision-making by the BLM, it would be desirable to tap this data source. This will be discussed in Section 6 of this report.

5.6 ROASTING PIT SITES IN THE MORMON MOUNTAINS

Roasting pits, including those near caves or shelters, account for nearly half the sites in the random and intuitive sample units. Figure 5-3 shows the location of sample units with roasting pits and shelters. An additional 29 roasting pit sites have been recorded either prior to or during this project outside of sample units. In sum, there are 129 open roasting pit or roasting pit/shelter sites, 49.6 percent of the known site inventory and well over a recent conservative estimate of 20 to 30 percent (Brooks 1982:272).

Most of what is known about this interesting food processing feature in southern Nevada is due to the work of Brooks and some of his students and staff at the Archaeological Research Center, University of Nevada, Las Vegas. Since 1975 three reports of survey and test excavations at roasting pit sites have been written (Brooks et al. 1975; Ellis et al. 1982a and 1982b). Progress on this continuing research project was summarized recently, and recommendations were made for management and additional study of this site type (Brooks 1982).

5.6.1 Site Taphonomy

Roasting pits exhibit considerable morphological variation. Some are large circular mounds over 1 m high and 10 m or more in diameter with central circular depressions often over 1 m deep. These are rimmed by calcined gravel-to-cobble-sized limestone rocks with dark stained soil including charcoal and ash. These striking features can scarcely be missed by pedestrians or even by motorists who pass nearby. Many have been recorded by USGS surveyors as "ruins" and are clearly visible on aerial photographs available from the USGS.

Other roasting pits are less prominent, including low mounds, level or nearly level mounds that lack a central depression and some marked only by a more or less circular scatter of calcined limestone. Rocks in one circular cluster of limestone recorded during this study (site 1.12.83 AM4) exhibit no evidence of thermal alteration. This anomolous rock feature may represent a phase in roasting pit construction and use. Although there were no roasting pits seen within 200 m of this feature (classified in this report as an isolated feature), there were six roasting pit sites recorded in the same sample unit. Isolated rock-lined pits or hearths may also be roasting pit related features. Finally, some of the roasting pits have been partially obliterated by road improvement, vehicular traffic and the construction or maintenance of guzzlers.

Prehistoric activity such as variations in the amount of repeated use of a roasting pit may account for differences in the size of the features. The

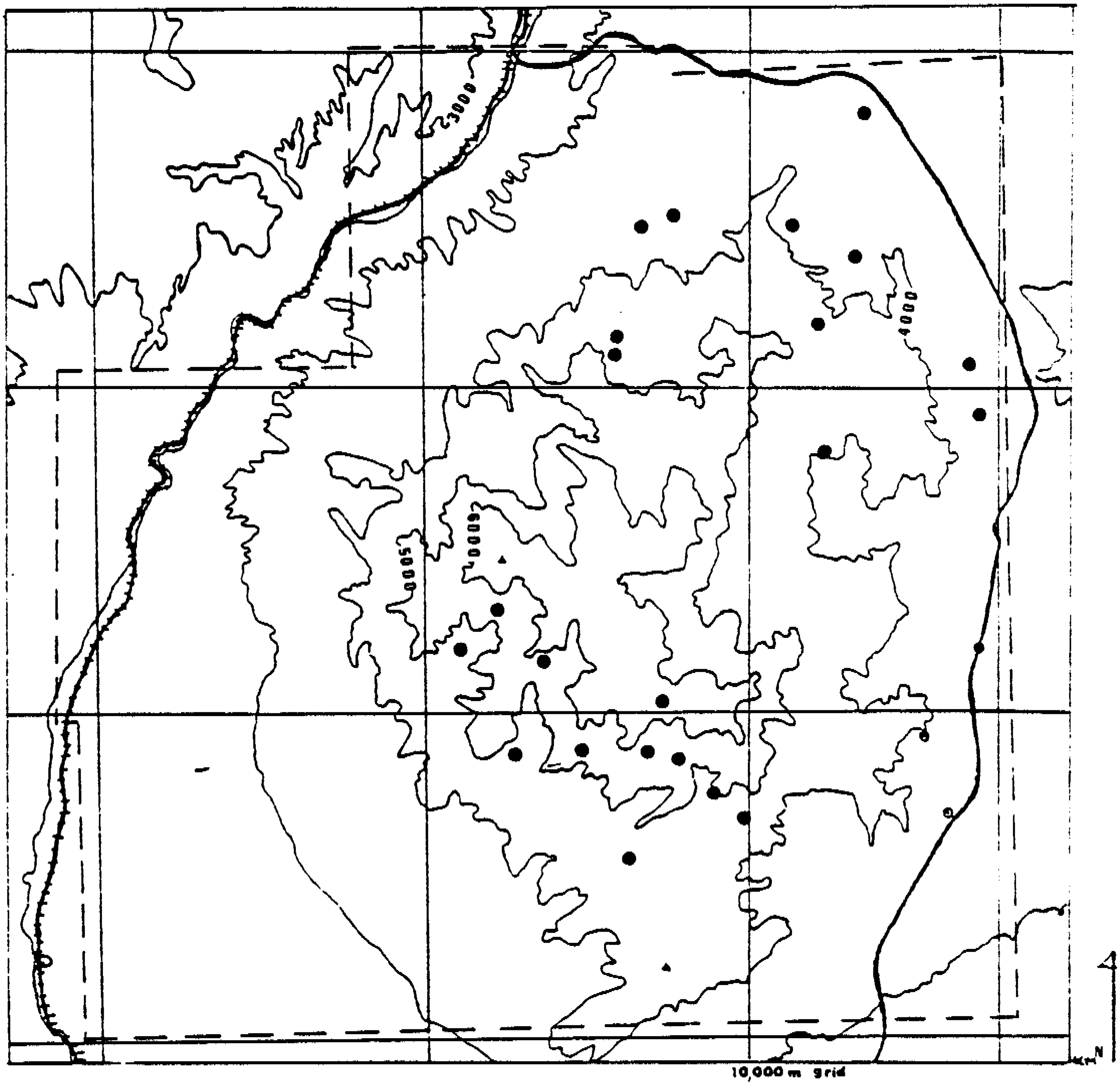


Figure 5-3. MAP OF THE PROJECT AREA SHOWING THE LOCATION OF ROASTING PITS RECORDED IN RANDOM SAMPLE UNITS

relative age of the features and their situation in respect to washes or other topographic features are also variables that may be associated with particular morphological characteristics. Clearly the effects of alluvial deposition account for much of the variation observed, such as the depth of the central depression that is in some features partially filled by silt, and the height of other features, partially buried by alluvial sediments. Other roasting pits have clearly been eroded and some surface scatters of calcined limestone may be the remains of roasting pit mounds from which smaller particles have been eroded. The effects of the post-depositional human activity mentioned above are usually easily identified, but it is less easy to recognize other recent effects such as the amount of artifact collecting that has taken place. One of the differences between and among roasting pit sites is the variation of the amount and types of associated artifacts.

At many of the roasting pit sites, recorders found one or more rocks that exhibit the characteristic scars of battering or pecking on at least one flat surface. These artifacts have been found at roasting pits in other locations in southern Nevada (Ellis, Green and Rolf, personal communication) and may be plant processing implements. The term "processing anvil" has been suggested for the artifact type (Rolf, personal communication).

The study of taphonomic processes has been urged by Brooks and his associates (cf. Ellis et al. 1982b:55, 56). Further systematic study should make the evaluation of the feature during surface surveys more reliable and perhaps results in a feature taxonomy that would reflect past human activity or other site formation processes.

5.6.2 Chronology

Radiocarbon dates available indicate the use of roasting pits from about 3000 B.P. through late prehistoric times. There are no radiocarbon dates from any of the roasting pit sites tested near Hackberry Spring, however, and it must be assumed the dates reported from 26CK1482 in the Hidden Valley, Muddy Mountains (1355 B.C.±125) and the late A.D. 1440±65 date from 26CK1081 in the Dry Lake Range (Ellis et al. 1982b:81) bracket the Mormon Mountain roasting pits.

Other chronological information includes the presence of ceramics and/or projectile points at ten sites and, possibly, the presence of pre-1900 metal and glass artifacts at four sites. In view of the ethnographic data recently reviewed by Brooks and his associates (Ellis et al. 1982a, 1982b; Brooks 1982), roasting pit sites with post-contact artifacts that predate the turn of the century may be particularly significant.

None of the roasting pits sites can be cross-dated with sites earlier than about 1500 B.P. on the basis of associated artifacts. Later in this report, Green discusses rock art sites in locations where numerous roasting sites occur. The frequency of Puebloan style pictographs apparently also indicate a date after A.D. 500 for at least some of the prehistoric use of the project area, if not the roasting pits themselves.

5.6.3 Roasting Pits and Shelters

One of the Mormon Mountain site types reflects the apparent association of some occupied or used rockshelters with roasting pits. These sites occur most frequently in broad flat-bottomed washes with deep straight-cut banks, and although these washes cut across mountain and piedmont strata, slightly over half are in Stratum 5. Table 5-14 shows that two-thirds of the shelters (Davis' "caliche caves") in piedmont strata are associated with roasting pits and nearly 30 percent of the roasting pit sites are roasting pit/shelter complexes, compared to much smaller frequencies for mountain strata.

The association of shelters and roasting pits has been observed in the California Wash and elsewhere (Brooks, Larson et al. 1975; Brooks 1982). Because of the apparent potential of some shelters to yield data on other activities that may have taken place during use of roasting pits, the roasting pit/shelter complexes merit special consideration in cultural resource management (see Brooks 1982:274).

5.7 ROCK ART IN THE MORMON MOUNTAINS (by Eileen M. Green)

Rock art is associated with nine sites in the Mormon Mountains Survey project area. Eight were recorded in project sample units and one was previously reported (26CK2418). The rock art includes pictographs (painted forms), petroglyphs (pecked forms), a sandstone slab with incised figures, and a small stone with an incised design. All are located in caves or rock alcoves with other cultural material present or close by. Figure 5-4 shows the location of rock art sites. Examples of the design elements are shown in Figure 5-5.

5.7.1 Hackberry Spring Canyon 26LN2418

This site occurs on the limestone walls of a narrow constriction in Hackberry Spring Canyon. On the east side is a large rock shelter with a deep colluvial apron that slopes to the canyon floor. Charcoal-darkened soil, flakes and pottery are present on the shelter floor and apron. In the west canyon wall are shallow alcoves with slight smoke blackening and floors of alluvial gravel with some intermixed fire cracked rock. The rock art panels include pictographs and petroglyphs in the rock shelter, as well as in and between two nearby alcoves. Carbonate seep deposits form a flowstone film obscuring parts of all the panels. A large roasting pit is located beyond the north end of the canyon passage.

The five rock art panels are as follows:

1. The rockshelter: 2 m above floor level on an interior wall near the entrance wall are three distinguishable petroglyphs and one pictograph. The petroglyphs are outlined ovals enclosing a grid pattern. There is faded red pigment on one figure. The pictograph is a black outline circle 35 cm in diameter enclosing a red dot and small black abstract line design.

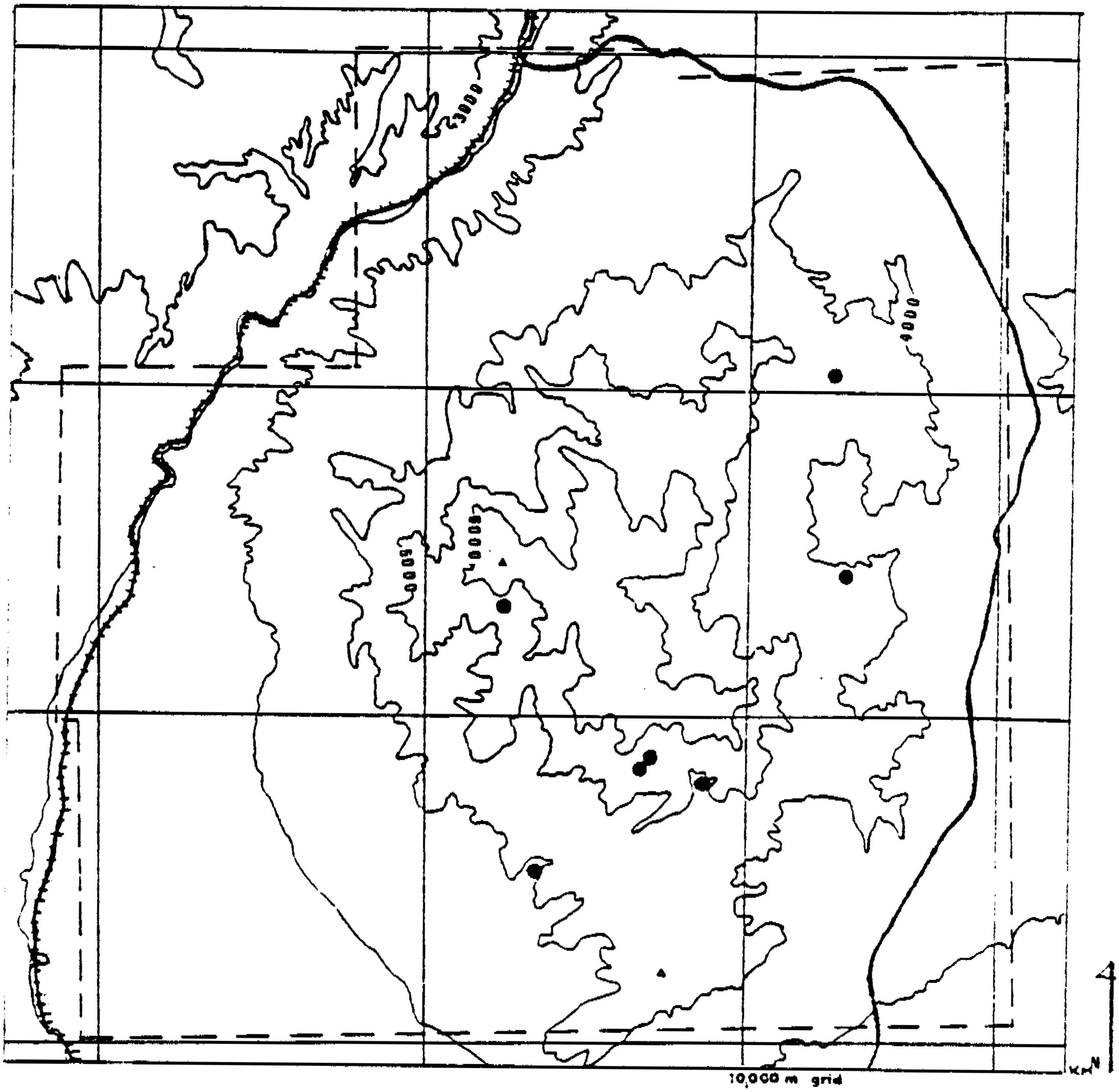
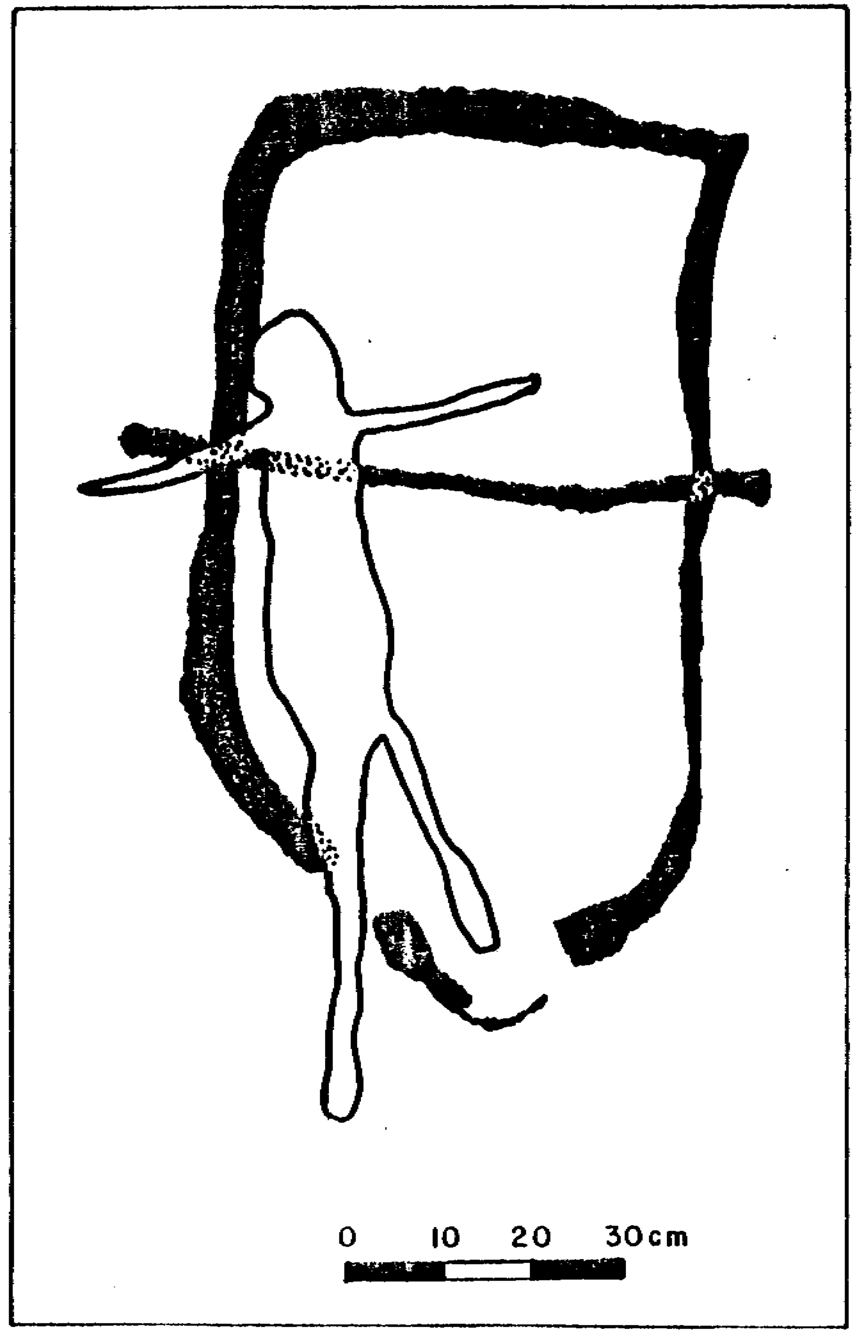
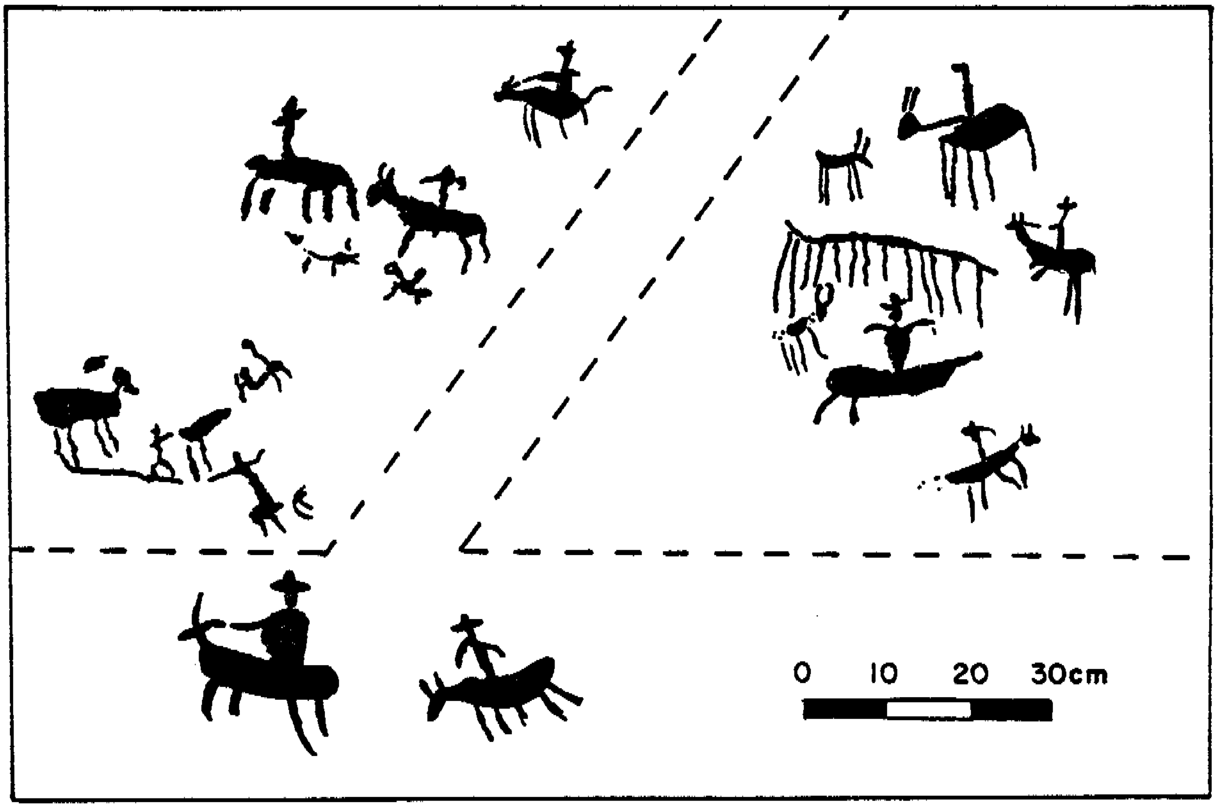


Figure 5-4. MAP OF THE PROJECT AREA SHOWING THE LOCATION OF ROCK ART SITES

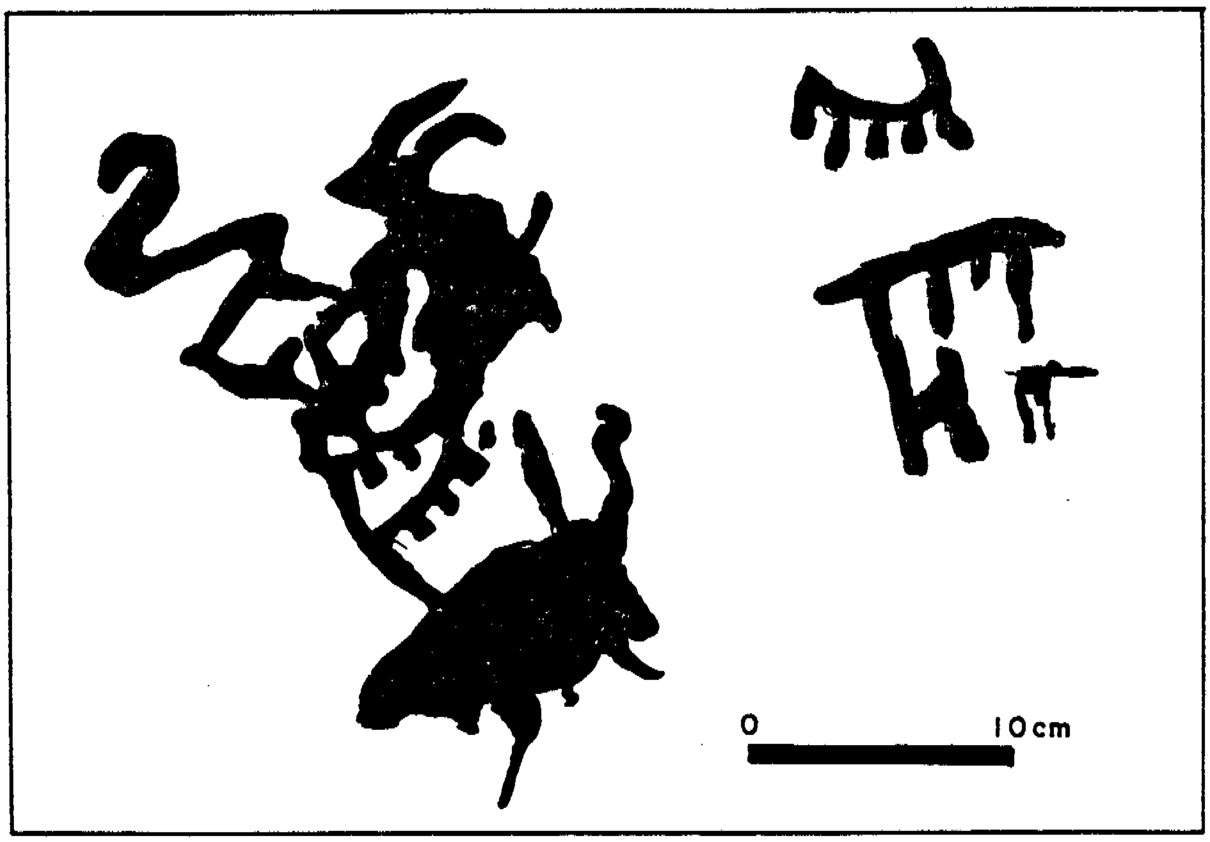


5-5a. 26LN2418, Hackberry Spring Canyon:
1. Petroglyph (red stain on lower element);
2. Red and black pictographs.

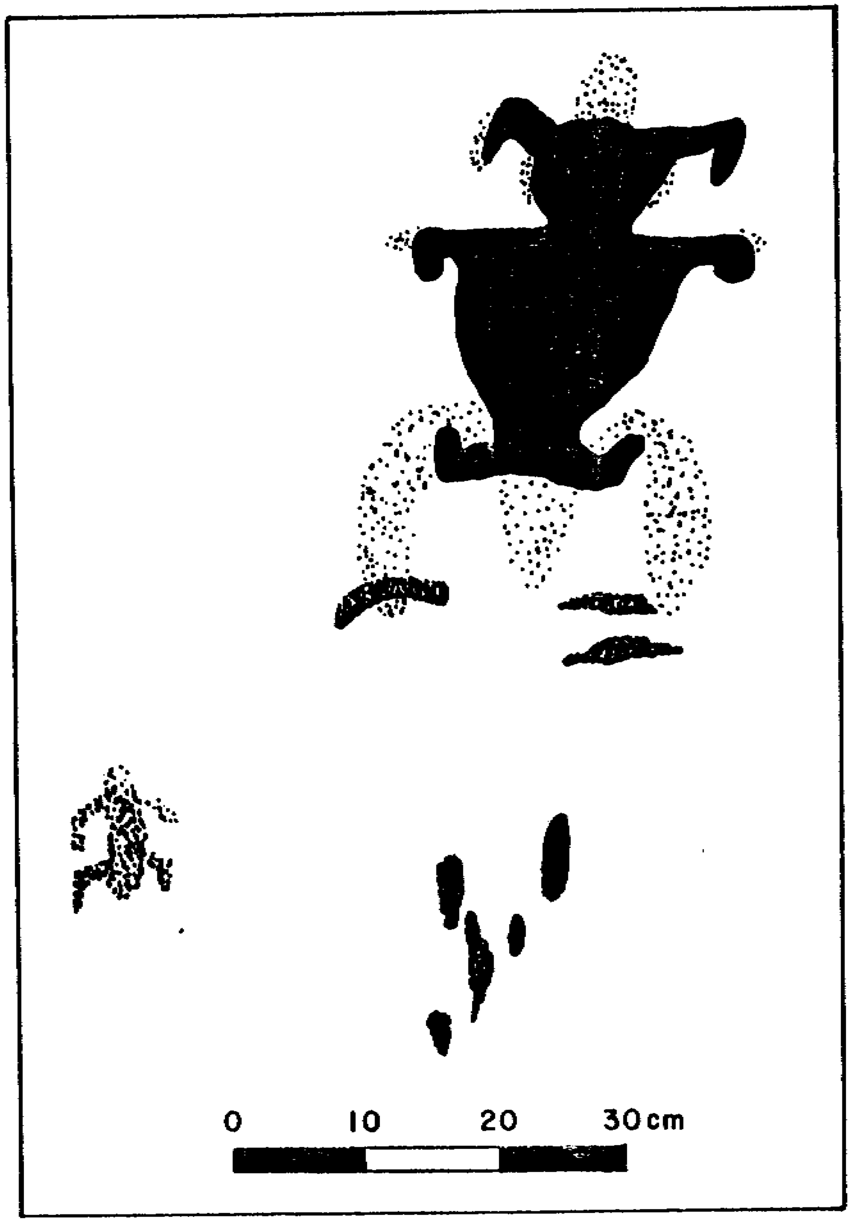
5-5b. 26LN2418, Hackberry Spring Canyon: Red and black pictographs.



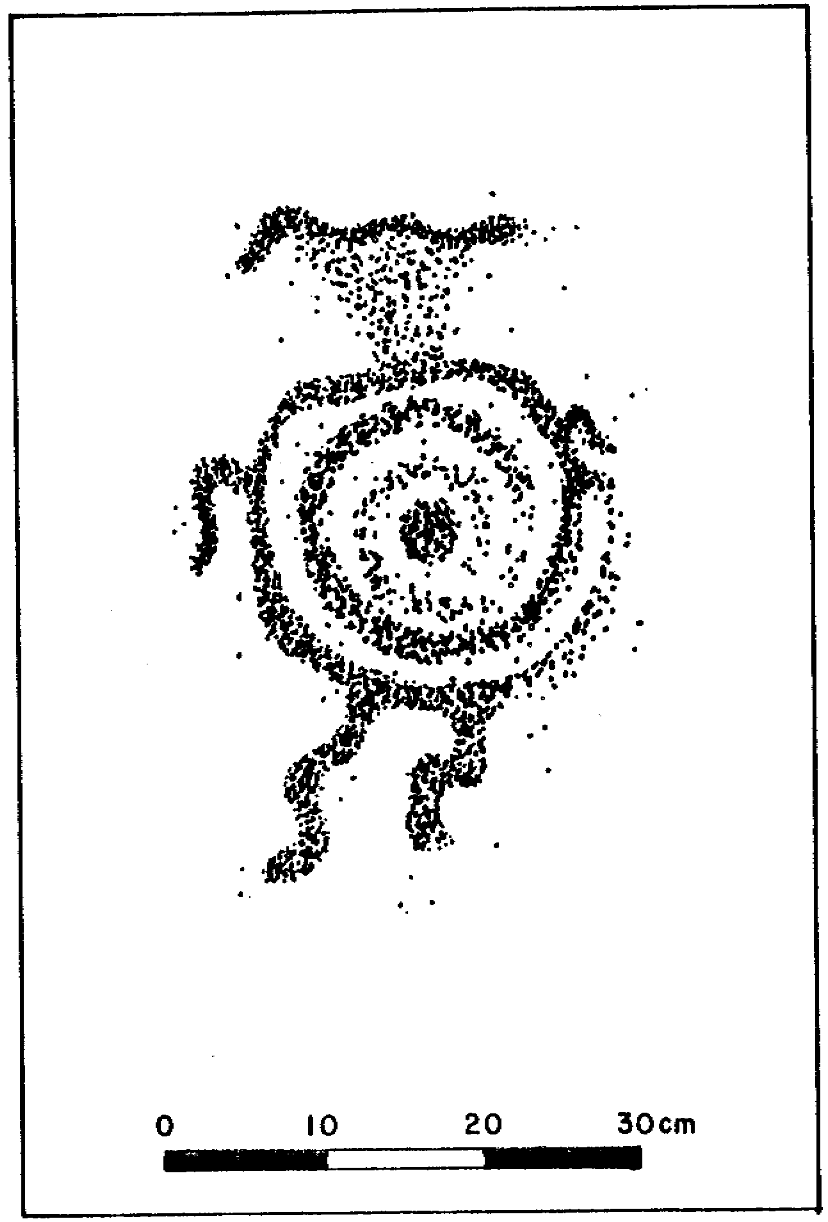
5-5c. 26LN2418, Hackberry Spring Canyon: black pictographs; rake is red.



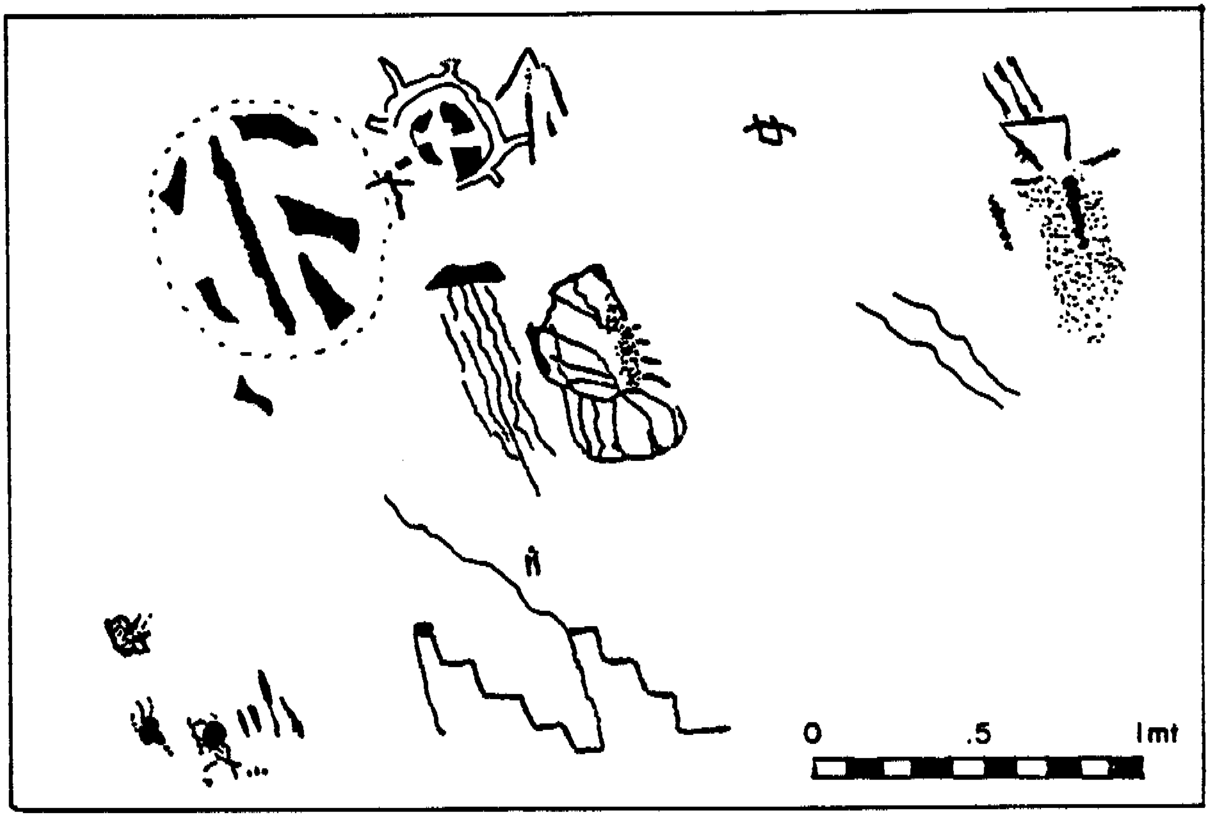
5-5d. 26LN2561, Whitmore Mine Road: red pictographs.



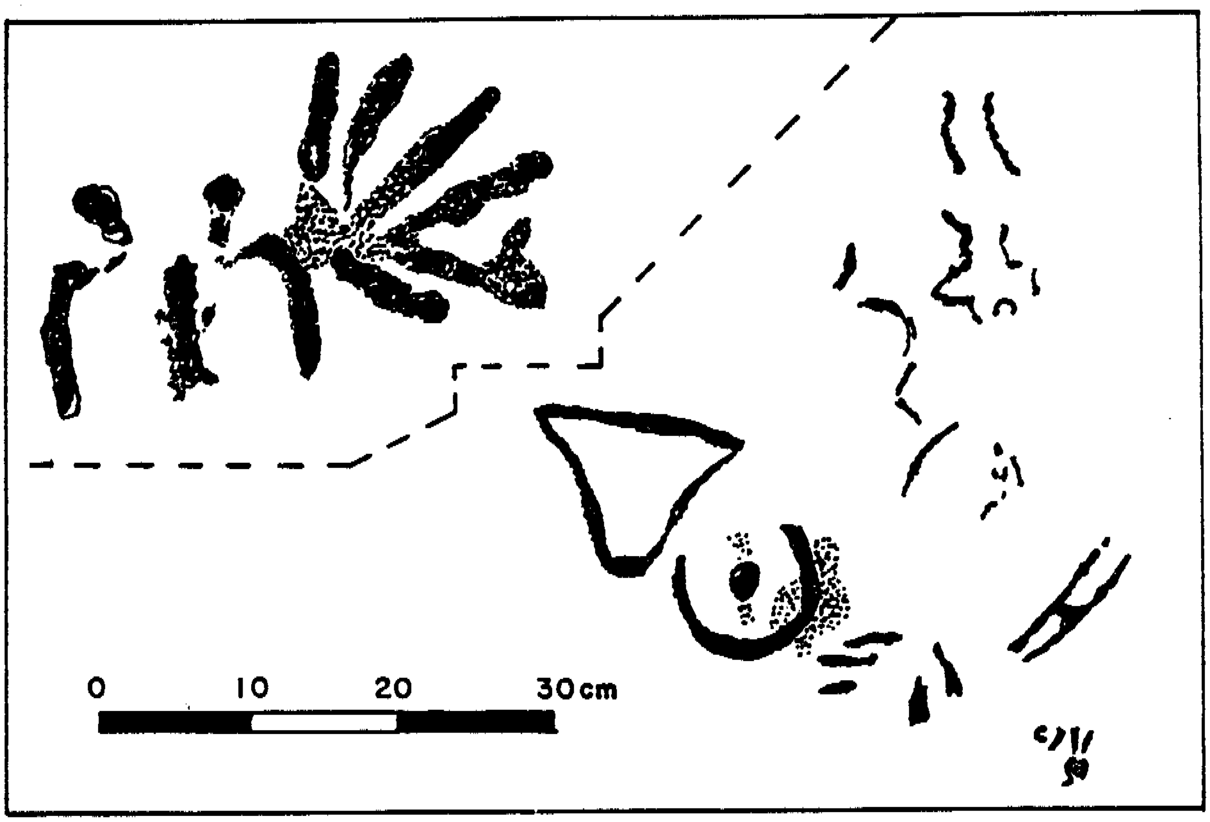
5-5e. 26LN2562, Yellow Man Cave: black, red and yellow pictographs.



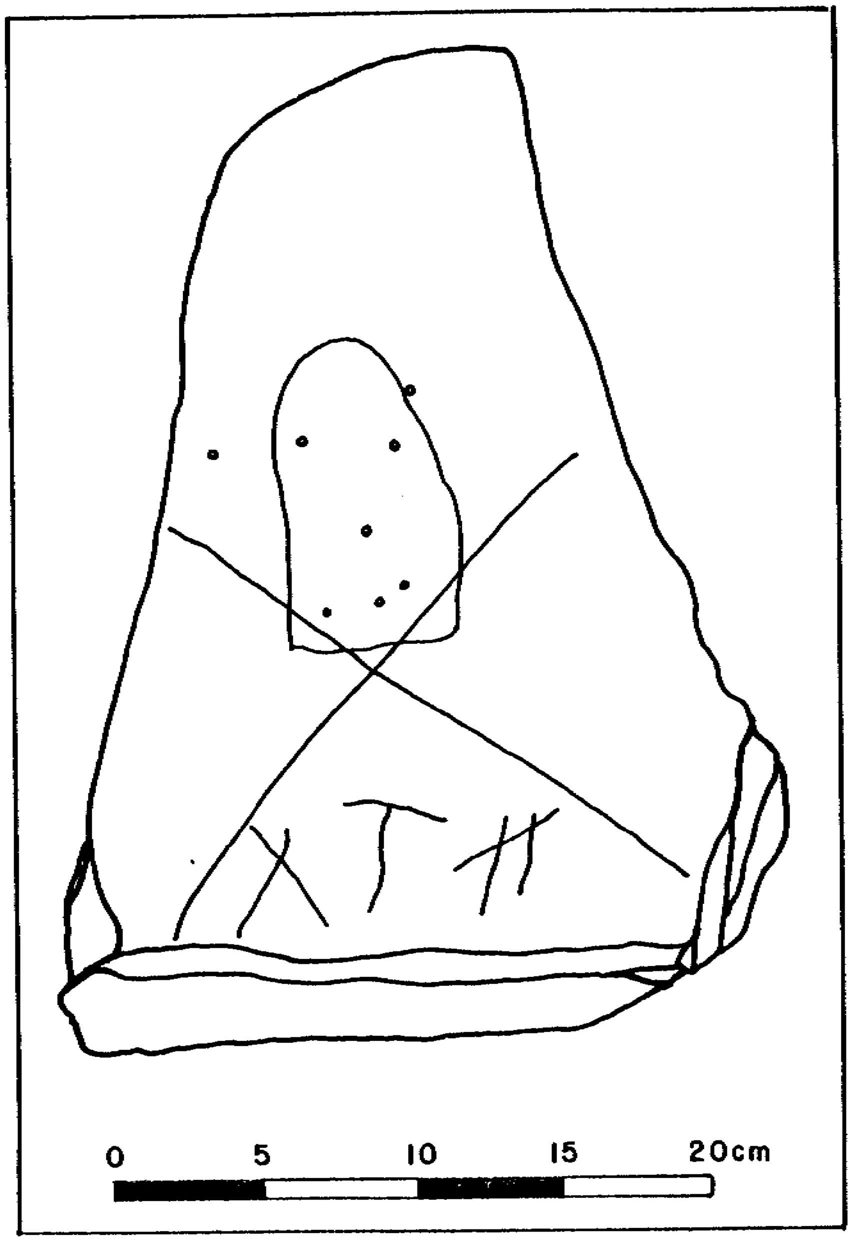
5-5f. 26LN2561, Whitmore Mine Road: petroglyph.



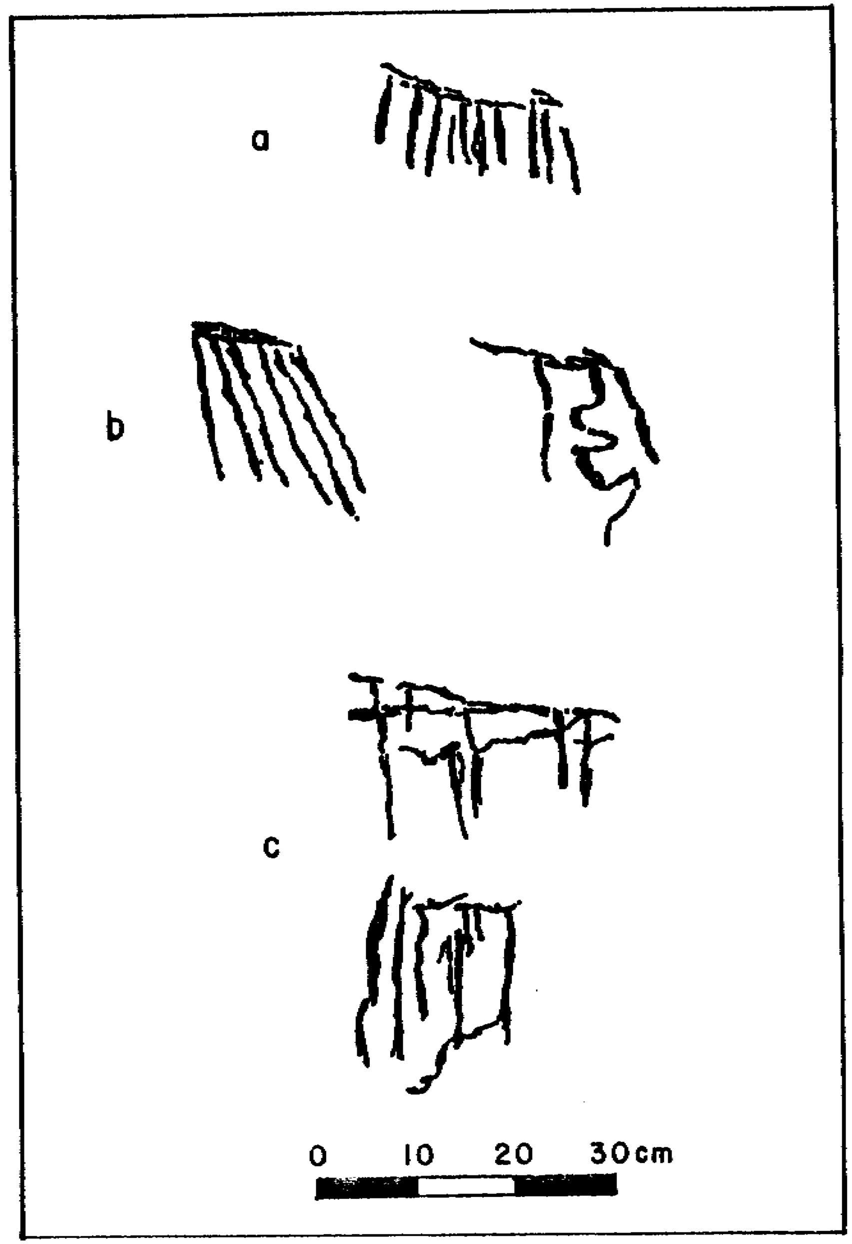
5-5g. 26LN2418, Hackberry Spring Canyon: black, red and white pictographs.



5-5h. 26LN2460, Toquop Cave: red pictographs.



5-5i. 26LN2611, Tinaja Shelter: petroglyph slab.



5-5j. 26LN2561, Whitmore Mine Road Site: red pictographs.

2. Directly across from the rock shelter is a shallow alcove with pictographs on adjoining walls. One panel is 4.3 m wide by 1.7 m high. The figures are in red and barely discernable white pigment:

   o A red outline circle 1 m in diameter, with an interior quartered design in remnant white and red;
   o Several red lines and circle fragments;
   o Two opposing stepped line figures common to ceramic, basketry, and textile designs;
   o A possible anthropomorph; the trapezoidal outlined head has three vertically projecting lines and is set on a larger trapezoidal upper torso. This element resembles some in caves and shelters in Meadow Valley Wash (Fowler 1973:120,127,128) and farther north at Balcer Creek (Schaafsma 1971:104);
   o Solid red oblong and roughly circular figures with pendant parallel thin lines;
   o Three red lines forming an arrow shape. The second panel consists of 12 to 15 small black quadrupeds with riders wearing hats. They are placed randomly and are superimposed on red line streaks and smudges.

3. A pecked swastika is on the outer canyon wall between No. 2 and No. 4.

4. A second shallow alcove panel shows 5 to 10 black quadrupeds and mounted men with hats in black and red.

5. Beyond No. 4 on the canyon wall, one red figure is almost completely obscured by flowstone; another element is a red outline rectangular shield with an interior black stick figure.

5.7.2 Whitmore Mine Road Rock Art Sites (26LN2561 and 26LN2562)

A broad ridge that forms the west side of upper Hackberry Spring Canyon is the site of a complex of four shelters with rock art (26LN2561), Yellow Man Cave (26LN2562), another cave (26LN2559) and a large roasting pit site (26LN1615).

Rock art panels at 26LN2561 are in shallow alcoves at the base of a limestone cliff. The pictographs are all in red pigment:

1. Two solid-body mountain sheep with attached sinuous line; two horizontal straight lines with pendant parallel lines; one upward curving line with pendant parallel lines; one possible mountain sheep;

2. A smudged figure with attached parallel lines;

3. One double and one single horizontal line with pendant parallel lines;

4. Petroglyphs: one barely distinguishable connected circle pattern; a possible "shield man" consisting of three concentric circles with appendages suggesting legs, arms, and a horned head.

A heavily vegetated colluvial apron is below the rock art alcoves. A brown ware sherd scatter in charcoal-stained soil occurs on the surface of the apron.

North of this rock art site, a steep colluvial slope leads upward to a cave with a shallow midden deposit and a surface scatter of flaked stone, Colorado buff ware sherds, ground stone and fiber quids (26LN2559).

Yellow Man Cave (26LN2562) is a large cave north and west, upslope from 26LN2561 and 26LN1615. The cave contains a shallow midden deposit in the rear behind a rock alignment of roof fall boulders. Pictographs are placed on a wall section at the rear of the cave and on a second section toward the front.

The "Yellow Man" element is a solid yellow painted trapezoidal body with short arms and legs projecting at right angles from the base and shoulders. The horned head is also a trapezoid shape. This element is superimposed over a larger indistinct black pictograph. Below this are several dark red smudges and a black figure which is possibly anthropomorphic. This is the rear panel.

The front panel consists of several small circle and line patterns in dark orange-yellow and reddish brown. Five tabular stone fragments on the floor below these figures are caked with pigment of the same color as the pictographs. The yellow color matches a rock layer exposed in the rear cave wall. On this panel is a pencilled legend " '34 Death Valley Curly Beatty Nev." This inscription is chiselled on the wall of the lower cave (26LN2561).

5.7.3 <u>Lookout Shelter (26LN2508)</u>

This shelter is on the southwest shoulder of Mormon Peak, and is a two-chambered cave with low boulder alignments extending from its two openings. A white marble stone with an incised abstract design is on the surface with obsidian and chert flakes, a corrugated gray ware sherd, a gray chert biface, an obsidian biface midsection, groundstone, yucca seed, burned and shattered long bone, and a possible human incisor. Three large roasting pits are on the floor of the wash below the shelters.

5.7.4 <u>26LN2611</u>

A sandstone slab with an incised abstract design was found in a small solution cavity in the lower part of a limestone hogback ridge on the west side of the valley between the Mormon and East Mormon Mountains. The slab is sub-triangular in plan, the decorated surface approximately 31 x 24 cm. The elements include three simple line figures that resemble the Greek letters <u>pi</u>, <u>tau</u> and <u>chi</u>. Above these is an outline lozenge shape with five pits arranged in horizontal rows of 2, 1 and 3 respectively. A large "X" is cut across the other figures.

Tinaja Shelter (26LN2610) is approximately 45 m (150 ft) from the sandstone slab site and slightly higher on the slope. The shelter floor and apron contain chert and obsidian flakes, an obsidian side-notched point fragment and pottery sherds including Pueblo, Colorado buff ware and Paiute brown ware. Level portions of the adjacent bedrock ledge contain shallow water catchment basins or tinajas.

Below these sites on an alluvial terrace are two eroded roasting pits (26LN2612).

5.7.5 Caliche Caves (26LN2550)

The rock art is in one of a a series of five rock shelters in the cut bank of South Fork Toquop Wash north and east of Horse Spring and the divide separating it from Hackberry Spring. The rock shelter with the painted figures is the largest of the three along a ledge in the cut bank. The figures are amorphous red pigment blotches on cobbles in the conglomerate that forms the shelter walls. A rocky slope extends down from the shelter to the present wash channel. Dark, charcoal-mixed soil and an artifact scatter of ground and flaked stone, a small desert side-notched point, burned bone, metal artifacts and leather scraps are present in and below the west of the Caliche Caves.

5.7.6 Toquop Cave (26LN2460)

This site is a solution cave in the mountain ridge forming the north end of a valley tributary to South Fork Toquop Wash. Pictographs are situated on an interior wall at the cave entrance. Red pigment used for the designs appears to be relatively unfaded. The elements are small individual line and circle forms:

1. An inverted half circle with central dot;

2. An abstract pattern consisting of a horizontal line with three pendant parallel lines, two small lines above and a fan shaped group of six lines radiating from one end;

3. A black line pattern of no clearly discernable shape.

Toquop Cave also contains obsidian and chert tools, burned bone, ground stone artifacts and fiber quids.

5.7.7 Obvious Shelter (26LN2591)

Three small and one large rock shelter are situated on a ledge midway up a steep limestone slope. One rock art panel is located on the east wall of the larger rock shelter. A 1 m^2 area is covered by a random pattern of criss-crossing narrow carbon-black lines. The other three shelters lack flat floor space and show no evidence of habitation or other human use.

The shelters face southeast over a deep valley trending south towards Mormon Mesa. Several roasting pit complexes, cut bank shelters, dispersed lithic scatters and isolated artifact sites were recorded in the valley.

5.7.8 Double Double Shelter (26LN2597)

This shelter is located on the steep slope of a limestone ridge forming the northwest side of the canyon leading to Whitmore Mine at its junction with the west-facing piedmont. Red pigment pictographs occupy a .5 x 1.0 m (2 x 4 ft) area on the rear wall of the larger of two adjoining alcoves. Design elements consist of short finger-width lines forming small vertical line abstract patterns and scattered solid patches of color. Carbonate seep deposits partially obscure the elements.

Double Double Shelter faces south approximately 25 m (8.5 ft) above a steep talus slope with intermixed charcoal stained soil, chert flakes and pottery sherds including Logandale Gray. The site name derives from the two adjoining alcoves that form the shelter and the two roasting pits at the foot of the talus. The midden on the floor of the shelter has some depth as shown in a pothole that does not expose bedrock to a depth of approximately 30 cm (12 in). Ground stone metates and fragments, flakes, a biface fragment and pottery sherds occur on the shelter floor and the exterior apron.

5.7.9 Discussion

Nine rock art sites are now known for the Mormon Mountains. Before this survey the only recorded site was the Hackberry Spring Canyon. It is noted on the USGS topographic sheet as "Petroglyphs," and was assigned a Nevada State Museum number in 1982. The other sites were not recorded until the present Mormon Mountain Survey.

The presence of an incised stone and a small portable rock slab with petroglyphs is remarkable for such a heavily travelled part of the project area. This rock art type is common in Southern Nevada (Santini 1974) and known at various places throughout the State. Painted and pecked elements on shelter walls offer few distinguishable forms. Recognizable design elements include anthropomorphs, stepped lines, horizontal lines with pendant vertical lines, concentric circles, large and small circle or grid outlines with interior lines or solid patterns and mountain sheep. These are familiar elements in the petroglyph and pictograph sites in the Muddy-Virgin River area. One distinctive characteristic of the Mormon Mountain rock art is the predominance of painted over pecked or incised elements.

Although the nine rock art sites are not spectacular compared to larger sites in southern Nevada, they are significant in several respects. Considering the small number of recognizable design elements, there are enough diagnositc elements to trace affinities with other rock art sites, to establish a relative chronology and to permit speculation about the purpose of rock art in southern Nevada.

The "Yellow Man" is an especially distinctive form, occurring as a petroglyph on the piedmont of the Virgin Mountains at Valley of Fire and in Arrow Canyon. Painted triangular-bodied anthropomorphs appear in Meadow Valley Wash, as noted above. The mountain sheep motif, which is often inferred to represent big-game hunting magic, appears at only one site (26LN2561) in the Mormon Mountains, a mountain sheep habitat. The horse-and-rider pictographs suggest that rock art production continued into historic Paiute times in southern Nevada. A panel similar to those at the Hackberry Spring Canyon site is repeated in the Red Rocks of the southern Spring Mountains. These men-with-hats, either mounted or standing alone, singly and in groups, appear in both pictographs and petroglyphs in the Muddy Mountains, Meadow Valley Wash and southern Spring Mountains (Green 1982). Mormon Mountain rock art appears to have affinities with sites to the north and east as well as to the south and southwest.

A loosely defined chronology is indicated by the Puebloan style and the historic design motifs in conjunction with field-classified ceramics. Dates from approximately A.D. 700 into the nineteenth century are indicated by a ceramic type sequence from the early Logandale Gray ware through Paiute Brown ware.

Finally, the Mormon Mountain rock art, like that in much of southern Nevada, is characterized by stylistic diversity and by its occurrence near other cultural features such as occupied caves, artifact scatters and roasting pits. Since the publication of Heizer and Baumhoff's major work on rock art, most studies have sought to show the relationship of rock art to big game hunting (Thomas 1976; Nissen 1982).

For southern Nevada, the association of rock art with habitation and food processing sites may place it within the larger context of subsistence procurement systems involving the full range of resources available in mountainous terrain.

5.8 OTHER PREHISTORIC SITE TYPES IN THE MORMON MOUNTAINS

Other site types in the Mormon Mountains include shelters, artifact scatters, isolated artifacts or features, and rock alignment sites. These site types were briefly defined above and their distribution in the project area has also been discussed. Here it is appropriate to summarize site information from the project records to permit a general evaluation of their significance and potential for future study.

Shelters and caves with smoke-blackened interiors, charcoal, ash, bone, fire-cracked rocks and artifacts or with at least one of these indicators of human use, are present in the mountains, where they usually occur in limestone cliffs. They are also present on the piedmont associated with rock outcrops or in conglomerate beds exposed in the deep, straight cut-banks of some washes. An even larger number of caves and shallow alcoves that are present exhibit no evidence of human use. Many of these, as well as many of the apparently used or occupied features contain modern or fossil Neotoma middens. Where observed, the presence of these middens was recorded on project maps.

The association of rock art and, in some cases, roasting pits with caves or shelters has been discussed above.

Artifact scatters and isolated artifacts or features are present in all parts of the project area, but they occur less frequently than in some parts of the Great Basin. A generally low artifact density characterizes scatters (from $1/m^2$ to $1/100m^2$ or more). Within scatters, artifacts are unevenly distributed with clusters of artifacts present in areas of very low density. Isolated artifacts tend to be flaked stone implements. Projectile points are relatively rare in the project area compared to others in the Co-Principal Investigator's experience. No quantitative data have been marshalled to support this intuitive assessment, however. Ceramics are associated with some of the scatters. One or more artifacts are present at some roasting pit or shelter sites and they resemble the scatter or isolated find site types in respect to artifact density and intra-site distribution.

Included among isolated artifacts or features are several alignments of rocks. Some of these are small circular alignments less than 1.5 m in diameter, most of which are associated with charcoal or ash mixed soil. One stone-lined pit approximately 1 m in diameter was also recorded. Examples of this rock alignment type are apparently associated with roasting pit sites. Other isolated rock features in the mountains are two linear piles of rocks tentatively identified in the field as possible hunting blinds.

A distinctive rock alignment site type, found thus far only in the Meadow Valley Wash stratum in this project area, is a linear arrangement of cobbles or small boulders in the desert pavement on terraces overlooking the Wash floor. Some of the Meadow Valley Wash alignments are more or less closed circles or rectangles of various sizes. Flaked stone and occasionally ground or pecked stone artifacts are present in and near several of the rock alignment sites. No temporally diagnostic artifacts were found near the features.

5.9 CHRONOLOGY

The presence of temporally diagnostic artifacts at some of the Mormon Mountain prehistoric sites permit limited inferences about chronology. The earliest point type is the Pinto (field classified) at one site, followed by Elko series points at two sites (including a previously recorded roasting pit site). Small triangular corner-notched or stemmed points were field-classified as Rose Spring and/or Eastgate points and probably represent regional variants of the type subsumed under the name Rosegate by Thomas (1981). Small triangular straight or concave based points were field-classified as Cottonwood Triangular and small side-notched points as Desert Side-Notched. Ceramic types examined in the field or among the small collection made include several Puebloan gray wares (Tusayan, Shinarump, Moapa and Logandale) and Southern Paiute or Shoshonean ceramics. A time frame encompassing Basketmaker III through Pueblo II, and late prehistoric possibly into early post-contact periods is indicated. Ceramic data indicate that many sites are multi-component (personal communication, Pat Olson, Lost City Museum).

Assuming a general relationship between the frequency of time-markers observed during the Class II survey and the intensity of land-use through time, it would appear that most use took place after A.D. 500. the presence of a relatively high frequency of Puebloan style rock art elements discussed by Green (above) after Heizer and Baumhoff (1962) is also consistent with this inference.

If the relative frequency of projectile points to other food-procurement or food-processing-related artifacts or features can be assumed to indicate the relative importance of hunting, it would appear that gathering or foraging were more frequently-occurring activities prehistorically in the Mormon Mountains.

Neither of the above assumptions has been supported by regional research. Lacking any specific confirmation, they are appropriate hypotheses that might be tested by archaeological research in the project area. Shelters and roasting pits may be expected to yield additional chronological information. Other investigators have found few projectile points during excavation and surface survey (Green, personal communication; Ellis et al. 1982:75). Faunal and perhaps plant food remains could be recovered during excavation of middens in and below shelters and associated with roasting pits. Appropriate field study could permit a more reliable inference about the relative intensity of land-use in the area through time and the relative importance of hunting to gathering plants or foraging for small animals.

5.10 HISTORIC SITES IN THE MORMON MOUNTAINS

Historic sites in the Mormon Mountains project area are present near roads, the railroad, springs and mining claims. Represented are features and artifacts that indicate temporary habitation (tent platforms, food or food-container remains), mining or prospecting (machine or hand excavations, ore samples, claim posts, mining tools such as picks), hunting (shotgun shells), stock-raising (water tanks, corrals) and transportation (railroad dumps with Union Pacific crockery, large food containers, structures including fences near the railroad, and sections of the early San Pedro, Los Angeles, and Salt Lake Railroad bed with associated debris).

Seven mining-related sites were recorded during the Class II survey. Most important are the Whitmore Mine and the Paint Mine. Others are a vermiculite prospect and other small claims and prospects.

The Whitmore Mine is a gold mine north of Wiregrass Spring in the central portion of the range west of its crest. Little information is presently available. It may have been part of the holdings of Brig W. Whitmore, an Overton resident with mining interests. Whitmore was president of a mining company in the Gold Butte mining district during the early 1900's (Las Vegas Age:January 17, 1906:4, col. 4; January 19, 1907:3, col. 3; April 10, 1909:1, cols. 5 and 6). Whitmore's connection with the mine in the Mormon Mountains, if any, is unknown to the authors of this report.

Around and below the mapped site of the Whitmore Mine is a large discontinuous scatter of trash including objects dating from around the turn of the century until the present. In this area of approximately 2 km^2 are several tent platforms, hand and machine-dug prospects, adits, a road network, mine tailings, etc. Three loci contain purple glass, bottles with tool-applied lips, hole-in-top cans and apparently only round nails, indicating use of those areas between around 1900 and 1918. Other tent platforms and trash scatters demonstrate a more or less regular but intermittent use of the mine for several decades. By 1945, when the World War II mining boom began to slack in Lincoln County (Roske and Planzo n.d.:22) the principle land-use was probably recreational.

The Paint Mine is on the site of a prehistoric quarry where both ochre and knappable stone were obtained. No temporally diagnostic artifacts were observed associated with the remains of the prehistoric industry. Extraction of the jasper for paint apparently began sometime before 1922, evidenced by the presence of hole-in-top cans. One tent platform, trash scatter is clearly post-1922 through the early 1940's. Beginning in the late 1920's ore was hauled by truck to Carp for rail shipment to Salt Lake City where it was used for paint by a roofing company (Roske and Planzo n.d.).

As Muñoz comments in Appendix II, mining is today of little consequence in the area. No evidence was found of substantial mining activity after the 1940's, although claims have been established as recently as 1981 near the Carp-Elgin road. Mineral production was never great enough to attract large numbers of miners or cause them to establish permanent settlements. Instead, mining camps were apparently both small and short-lived. Archaeologically, these sites have much the same kinds of information to offer as small artifact scatters. They are single component and usually single purpose sites. Unlike their prehistoric counterpart, the ephemeral mining sites can usually be dated with some precision, estimates made of household size and composition, and activity areas delineated (cf. Reno n.d.).

5.11 OTHER RECENT ARCHAEOLOGICAL STUDIES IN SOUTHERN NEVADA

Several recent archaeological studies have been referred to above in connection with roasting pit sites and rock art (e.g., Brooks et al. 1975; Ellis et al. 1982a and 1982b). Another recent study is particularly germane to the Mormon Mountain Class II Survey. This is the survey in that part of the overthrust belt within the Virgin Valley Planning Unit reported by Bergin and others (1980). The sampling design developed for the Mormon Mountain project was designed to be comparable insofar as definition of strata and size of quadrats are concerned. This was to permit comparison of results, a goal only partly realized, however, not because of differences in method, but because of differences in the two study areas and the way they were selected.

In the Mormon Mountains, the entire range within Lincoln County was selected for survey. For the other study a series of tracts, most of them Townships, were selected for study. Three of these tracts surveyed are in the west and southwest parts of the Muddy Mountains with terrain similar to the Mormon Mountain study area. Comparison of results therefore must focus on these portions of the overthrust belt survey. Certain differences between the archaeological distribution in the Mormon and Muddy Mountains are apparent. It is clear that the Mormon Mountain piedmonts exhibit a markedly greater site density and variability than the similar terrain sampled in the Muddy Mountains. Bergin (et al. 1980:Table V, VII) reports the recording of only three artifact scatters and ten isolated specimens in six randomly selected 160-acre tracts, compared to our finding that the same site types occur on both piedmont and mountain strata.

In contrast, mountainous terrain in the two study areas is similar as to site density, but not as to the types of sites present. Random and intuitive sample units in the Muddy Mountains (42 units, each 160 acres) yielded 50 sites compared to 50 randomly selected 160-acre units in the Mormon Mountains which yielded 78 sites. The site per acre density is thus nearly the same. It should be noted, however, that by including intuitively with randomly selected units in the Muddy Mountain data we are biasing the data in favor of a higher site density than may be representative of the Muddy Mountains as a whole. The predominant site type in the Mormon Mountains (open roasting pit sites) is apparently absent, however, in the two randomly surveyed Muddy Mountain tracts (Areas 1 and 3, Bergin et al. 1980), where artifact scatters and rock shelters are the major site types. Open rock art sites are present in the surveyed portions of the Muddy Mountains, but in the Mormon Mountains, rock art is strongly associated with shelter interiors, some of which have no other surface indications of human use.

These results should be treated with caution, however, because as noted above we are comparing a stratified sample of one whole range with a stratified random sample of two tracts in one part of the other range. We cannot tell whether apparent differences between the Mormon Mountains and those portions of the Muddy Mountains sampled are attributable to "real" differences or to bias introduced by the limiting of the stratified sample to the northern part of the Muddy Mountains. In fact, the presence of roasting pit sites in another Muddy Mountain tract sampled intuitively strongly suggests that this may be the case.[4] The primary value of the Mormon Mountain study in relation to the Muddy Mountain study is that the two projects focus on different terrain types and therefore complement each other as comparable samples of a wider range of southern Nevada topographic zones.

[4] A subsequent report, in fact, (Ellis et al. 1982a) reports a roasting pit at one site in Area 1 (26C1481).

5.12 SUMMARY AND DISCUSSION

The archaeological survey of an 8 percent stratified random sample of the Mormon Mountains resulted in an addition of 215 sites to the original meager site inventory of that area. Moreover, the site inventory now includes additional site types, correcting the bias of pre-1983 inventory data. A 2 percent intuitive sample of the Mormon Mountains permitted the exploration of certain areas of expected high site density not adequately sampled by random units, for example the Meadow Valley Wash. The main benefit of the intuitive sample, however, was the augmentation of the inventory of certain significant site types. That is, the intuitive survey sought to find additional rock shelters and roasting pit sites instead of adding to the inventory of isolated specimens and small lithic scatters. Finally, in the intuitive sample it was possible to seek more examples of certain rare site types, specifically rock art and the Meadow Valley Wash rock alignments.

The success of the intuitive sample is shown by a site density over 2.5 times that of the random sample or all sites. A much greater representation of rare sites (four to five times as many) and a higher ratio of roasting pit and shelter sites to isolated artifacts and small artifact scatters in the intuitive sample than in the random sample indicate that major goals of the intuitive sample were met.

Site distribution and, particularly, site density in the mountains and piedmonts were addressed by using the randomly selected quadrats as the analytic unit instead of using sites themselves. This analysis failed to confirm an apparent difference in site type distribution between mountains and piedmonts. That is, 160-acre quadrats with various site types (roasting pits, shelters, artifact scatters or historical sites) occur in the same relative frequency in the mountains as in the piedmonts. This is in spite of the manifestly greater frequency of roasting pit sites and shelters compared to isolated specimen and artifact scatter sites in the mountains than occurs in the piedmonts (cf. Table 5.2 above). A comparison of units according to the number of sites present in each unit, however, showed a significantly greater site density in mountain than piedmont sample units.

In the mountains, quadrats with sites were found to cluster within 3 km of springs and on the same side of major divides as the springs. Quadrats without sites are farther from springs and/or across major divides. Sample units with sites are along major washes, particularly in piedmont strata where sites were seldom found elsewhere. Finally, relatively few sites were found in the northwest portion of the project area except for immediately along the Meadow Valley Wash (within 400 m or 1,320 ft of the present channel). In contrast, site density in the mountains is relatively high within a 3 km (1.86 m) radius of springs except across major divides from the springs. Moreover, margins of ephemeral spring-fed washes have a site density more comparable to the Meadow Valley Wash area than to other topographic situations in the project area.

The most frequently occurring site type in the study area is the roasting pit site. The co-occurrence of roasting pits and shelters is a significant finding, particularly for major steep-sided drainages low in the piedmonts where roasting pits occur relatively far from agave habitats. Also of interest is the presence of a distinctive artifact type (possibly a food-processing anvil), flat rock slabs that exhibit scars of battering. Finally, the finding that some roasting pit sites may have been in use after White contact confirms that ethnographic accounts of this site type in other areas apply to the Mormon Mountains and, probably, neighboring areas as well.

The small inventory of shelters may be most valuable for their preservation of paleocological information. They may, however, yield information about the use of associated roasting pits as well. Rock alignments such as those in the Meadow Valley Wash are poorly understood and information is urgently needed before their significance can be adequately assessed.

The rock art inventory is small, but the complexity of the Mormon Mountain rock art, its apparent persistence into relatively recent times and its associations with habitation as well as plant-processing areas pose problems that may guide important new regional research.

Finally, in the area where temporary seasonal resource exploitation has been the only apparent human land-use ever, historic sites offer the possibility to learn about such ephemeral patterns in the context of sites that 1) can be precisely dated, 2) can provide detailed archaeological information about the number and gender of site occupants, and 3) can inform us about the length and purpose of occupants' sojourn in the mountains.

As mentioned above, no fully comparable survey has been reported for mountains in southern Nevada. Data from several recent studies pertain, however, to the evaluation of roasting pit and rock art sites and one has yielded relevant site distribution data. The completion of major surveys conducted in connection with MX siting or military operations on the Nevada Test Site will significantly augment the available site distribution data base. Together these projects with the one reported here provide a basis for intelligent cultural resource management and will, we hope, stimulate more and better regional archaeological research.

Section 6

RECOMMENDATIONS

The results of the Mormon Mountain Class II survey are the basis for recommendations for cultural resource management policy making and implementation. Essentially these recommendations seek to guide the Bureau of Land Management in making four basic decisions about the cultural resources in the Mormon Mountains:

1. Which sites to save;
2. Which sites to excavate or collect;
3. Which sites to sacrifice if necessary; and
4. What mitigating actions should be undertaken when significant sites are threatened.

6.1 WHICH SITES TO SAVE AND WHICH CAN BE SACRIFICED

The question of which site to save is one that often confronts cultural resource managers when a choice must be made among alternate locations for some site-destructive land-use. The preferred alternative when cultural resources are concerned is one that will destroy no sites, but often the choice must be made between alternate locations that will affect cultural resources.

<u>Efforts should be made to save all of the relatively rare, significant site types in the project area.</u> In the Mormon Mountains these site types are:

- Caves or shelters with rock art on interior walls;
- Shelter/roasting pit complexes;
- Segments of the early railroad bed with associated structures or artifact concentrations; and
- Possibly, early structures in Carp, such as the previously recorded school.

<u>Efforts should be made to save a sample of other significant, but more frequently-occurring site types.</u> These site types are:

- Roasting pits;
- Caves or shelters;
- Artifact scatters and isolated artifacts and features including those of the post-White contact period.

It would be no less a loss to the public for all examples of one of these site types to be lost than for the loss of the more rare site types. It simply is less likely to occur and when the choice must be made between one of the rare and one of the more common sites, there is less risk in sacrificing one of the latter.

6.2 WHICH SITES TO STUDY

One of the most devastating effects on archaeological sites is archaeological research itself. Destructive archaeological study should be allowed only when the Principal Investigator can demonstrate that adequate support is available for appropriate field work and to carry the project through analysis and reporting.

So little recent systematic archaeological research has been done in the Mormon Mountains or in similar terrain that well designed and supported research projects should be encouraged at least until all site types have been studied. This is a high management priority because the results of such research would provide a better basis for cultural resource management decisions.

The Bureau of Land Management cultural resource specialists should establish priorities for archaeological studies they need in the Mormon Mountains to manage the resource most effectively. High priority studies should be solicited and given such financial or other support as feasible within the District office work program.

Several studies are suggested on the basis of results of the present Class II survey:

- Computer-assisted analysis of specific environmental variables associated with site distribution;
- Sampling and analysis of fossil *Neotoma* middens in the project area for paleoenvironmental data;
- Systematic and complete recording of all known rock art sites and further survey in high rock art density areas; analysis of pigment samples;
- Additional studies of roasting pit sites or roasting pit/shelter complexes as recommended earlier (Ellis et al. 1982b);
- Mapping and study of early railroad bed remains and associated structures and artifacts, and a sample of the mine/prospect/camp sites;
- Study (including such excavation as necessary) of one of the rock alignments in Meadow Valley Wash; and

- o Mapping and sampling knappable stone sources, such as the opportunistic quarries reported here.

How to evaluate research designs presents problems for land management agencies even when there are archaeologists on staff. The BLM staff archaeologists are encouraged to seek consultation with their colleagues in reviewing antiquities permit applications, perhaps through an established regional review panel. Certainly before destructive research is permitted in any of the relatively rare site types, research designs should be carefully reviewed and the proposing Principal Investigator should be given the benefit of reviewers' comments.

Finally, many of the sites in the Mormon Mountains are small and relatively fragile. Small-scale test excavations, if not directly followed by full excavation, damage and disrupt the deposits. Testing of these sites to establish their significance is not indicated unless they are subject to direct adverse impact and a mitigation program is being planned. Instead, the excavation and complete systematic surface collection of a small number of sites that are representative of the known site inventory is preferred. The results of intensive study of a few sites should be evaluated before more sites are committed to destruction by archaeological research. Investigation of a sample of the single component mining-related sites or localities could contribute to our understanding of prehistoric, as well as, historic resource procurement strategies in marginal areas (after Reno n.d.). In order for cultural resource managers to make appropriate decisions about which sites to save and which to sacrifice and how best to plan for mitigation, efforts should be directed now towards encouraging and assisting research of the kind described here.

6.3 MITIGATION OF ADVERSE EFFECTS ON ARCHAEOLOGICAL SITES IN THE MORMON MOUNTAINS

Data collection from sites subject to adverse effects has been the favored mitigating activity and will probably remain so. When a site is expected to be partly or completely destroyed there is little justification for failing to collect as much information as feasible before the destruction takes place. Nor is the excavation of sites that are safe from destruction usually desirable. The public interests are not necessarily served best, however, by data collection at sites under immediate threat of destruction. Work at such sites must often be hastily planned and executed.

In such cases a viable alternative might be to channel a portion of the resources available for mitigation to support research at sites similar to the types impacted by the threatening land-use. After evaluation of the impacted sites, mitigating data collection might then be directed towards a more carefully conceived, long-range study of similar site types in the area.

Before such a mitigation plan is undertaken, it should be subject to careful peer review, and conflicts with present conservation goals should be resolved. Moreover, such a mitigation program should be undertaken only in cases where sufficient time and resources are not available for well designed and supported study of the impacted sites.

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Appendix I

CONSULTATION WITH NATIVE AMERICANS OF THE MORMON MOUNTAIN REGION

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The Native Americans of Moapa Reservation and of the Las Vegas Colony were contacted as part of the Class II Mormon Mountains survey, the former by telephone, letter, and in person, the latter by telephone and in person.

On November 11, 1982, Co-Principal Investigator Rusco and Ethnohistorian Johnson met with Billy Frye, chairperson of the Las Vegas Colony's Tribal Council, to discuss the archaeological survey. Chairperson Frye expressed interest in the survey and mentioned several tribal members who might be willing to assist the staff. Chairperson Frye observed that artifacts had been found on the colony and that Southern Paiute religious sites were being obliterated in the Las Vegas area. Further attempts to meet with Tribal Chairperson Frye of the Las Vegas Colony were futile, although telephone calls and appointments were made. Attempts to locate a Colony member who allegedly has old photographs of the Mormon Mountain area were also futile.

On November 12, 1982, Co-Principal Investigators Rusco and Muñoz and Ethnohistorian Johnson met with Preston Tom, Moapa Tribal Chairperson. The archaeological survey was described to him, and he agreed to discuss it with the other tribal members at the next tribal meeting. He agreed to forward any concerns about the survey area (sacred sites, unique natural resources, etc.) to the Bureau of Land Management through the Co-Principal Investigators, in care of the Nevada State Museum, Las Vegas; none has been received to date (3/25/83).

Reservation elder Herbert Meyers was consulted about his knowledge of the resources of the Mormon Mountains. He described a cave on the east side of the mountains in which moccasin soles (later identified as the remains of Basketmaker II sandals) had been found, describing the cave as "a place where Indian people leave things." Meyers agreed with Johnson that the caves may have been used for religious activities by Indian doctors, whom he called "witch doctors." Meyers spoke also of Indian trails which narrow gradually as the elevation increases and down which mountain sheep might bound, knocking a person on the trail into the chasm below. He stated that there are remains of several such bodies, impossible to retrieve from either above or below. Finally, he mentioned the existence of springs in the Mormon Mountains.

Meyers accompanied Rusco, Muñoz, and Johnson to the Mormon Mountains November 14, 1982. He denied knowledge of Paiute names for topographic features, stating that those who did know such terms were deceased. He gave the same response to questions about legends connected with the area.

He pointed out the locations of springs accurately, told the best routes by which to reach the tops of peaks, identified mountain sheep tracks, and shared some of his botanical knowledge, adding that elders had warned him not to divulge the medicinal use of particular plants to non-Indians.

The lack of in-depth response on the part of the Moapa Reservation and Las Vegas Colony Indian people should not be misconstrued as lack of interest in or concern for the cultural resources of the Mormon Mountains. Contacts with the Southern Paiute were limited by several constraints (time, informant resistance, busy schedule of the Native American consultants), and additional contacts would surely elicit specific concerns. It is anticipated that their primary concerns are with water resources (particularly that of Meadow Valley Wash which skirts the Mormon Mountains on the west), sacred sites such as burial grounds, and plant resources (especially those used for medicinal purposes).

Appendix II

HISTORIC OVERVIEW OF THE MORMON MOUNTAINS

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The aboriginal inhabitants of the Mormon Mountains area were the Southern Paiute or Nuwuvi. Six major bands of these desert people occupied portions of southern California, southern Nevada, northern Arizona, and southern Utah. One of the larger bands--the Moapits--occupied the Mormon Mountains area.

The Moapits and other Southern Paiute were primarily hunters and gatherers, relying on a cyclical harvest of available plants and animals for food and materials for shelter and clothing. Bands often joined together for communal hunting and particular areas and their resources were often shared among and between groups. Food gathering and hunting were carried out in all major biotic zones, in as environmentally harmonious a fashion as possible. Some of the Paiute, among them, the Moapits, practiced minimal agriculture. Certain natural phenomena were held in greater reverence than others, especially water resources such as springs and rivers. (For additional details on these people, see Kelly 1934, 1964; Euler 1966; Inter-Tribal Council of Nevada 1976; Alley 1977.)

Escalante and his party may have been the first non-Indians to see the Mormon Mountains (1776), and Jedediah Smith the first Anglo American to do so (1826 and 1827). Smith's route between the Great Salt Lake and Los Angeles has been debated for decades (see Fletcher 1929, Merriam 1923, Morgan 1953), but evidence suggests strongly that he came south through Meadow Valley Wash. There he observed "Pa Ulches" wearing rabbit skin robes and raising corn and pumpkins.

The first non-Indians to settle in the Mormon Mountains area were members of the group after whom those mountains were named. A Mormon exploration party camped in the northern portion of Meadow Valley, near a spring, in 1858. There they built corrals, dug irrigation ditches, plowed several acres, and planted grain. Brigham Young recalled them to southern Utah, however, and they left the crops in the care of the Moapits upon their return to the Salt Lake area (Roske and Planzo n.d.:3). Permanent Mormon communities were established in the 1860's, including Panaca, Eagle Valley and Clover Valley in the upper part of Meadow Valley Wash and Moapa, West Point, St. Joseph and St. Thomas along the Muddy River. Some of these settlers made use of the Mormon land improvements made in 1858 (Roske and Planzo n.d.:6).

Mining in the region just to the north of Meadow Valley began in the mid 1860's, and the 60 miles square Meadow Valley Mining District (later called Ely) was founded in 1864. It is speculated that mining claims were staked by Mormons in an effort to keep non-Mormons out of the area, and certainly the

Mormons came intending to stay, as they brought horses, cattle, sheep, and their families with them (Roske and Planzo n.d.:5).

Relations between the local Indian people and the incursive non-Indians were occasionally strained, as were those between the Mormon settlers and non-Mormon miners. Most of the conflict between Mormon and non-Mormon occurred some miles distant from the Mormon Mountains, particularly in Pioche to the north, and continued for many years. Boom towns formed near mining districts, most of them to be abandoned within a few short years.

Communication and transportation in southeastern Nevada improved during the mining boom of the late 1860's and early 1870's. Post offices were established at many locations, four in or near the project area:

Carp. Settlement at this location began about 1907, and the town was first named Cliffdale after the cliffs surrounding it. Postal operations began June 7, 1921, under the name Cliffdale, with the name changed to Carp December 1, 1925. The first postmaster was also the operator of the UPRR station at Carp (Carlson 1974:70).

Elgin. The post office at Elgin began service March 3, 1913. It and the railroad station are about a mile south of the site of the town of Elgin, which was settled in 1882 (Carlson 1974:107).

Moapa. The Moapa post office was established July 22, 1889. (Carlson 1974:169).

Rox. The post office at this settlement was in operation from 1921 to 1949 (Carlson 1974:206).

The San Pedro, Las Vegas and Salt Lake railroad, precursor to the Union Pacific line through Meadow Valley Wash, was completed in January, 1905. Floods plagued the railroad, washing the track out numerous times, and alternate routes were considered but rejected. A new "High Line" was constructed, with "10 new tunnels, 24 steel bridges, and a complete reconstruction of 74 out of 86 miles of track between Barclay and Guelph" (Ruske and Planzo n.d.:20). Ten place names within the project area are associated with the railroad:

Carp. Carp is both a post office and a station on the main line of the Union Pacific Railroad, 38 miles south of Caliente. The town of Carp was first settled in 1907, at which time it was named Cliffdale after the surrounding cliffs. Railroad officials named the station Carp after an employee, and the post office adopted that name in 1925 (Carlson 1974:70).

Cloud. This railroad siding was abandoned in 1949. It is four miles north of Carp, and was originally named St. George. The name was changed to Rappelje in 1920 after an official of the Union Pacific, and then to Cloud in 1928 (Carlson 1974:80).

Elgin. The town of Elgin was settled in 1882 about a mile north of the present post office (established 1913) and railroad station (Carlson 1974:107).

Farrier. This station was on the old San Pedro, Los Angeles and Salt Lake City Railroad line, at which time it was called Guelph, a name which "commemorates either a member of a German royal family, or a member of the Guelph family or political party in medieval Italy" (Carlson 1974:129). After Union Pacific purchased the SPLA and SLRR, the name was changed to Farrier in honor of a UPRR official (Roske and Planzo n.d.:19, Carlson 1974:112).

Galt. Galt is a non-agency station located 10 miles south of Carp on the UPRR (Carlson 1974:117).

Hoya. The UPRR siding of Hoya is approximately 20 miles north of Moapa. Gravel for railroad construction and repair was mined from the Hoya Pit, about 2 miles north of the station in Meadow Valley Wash. The mine is abandoned (Carlson 1974:138).

Leith. Leith is another non-agency station on the UPRR. It is 10 miles south of Elgin in Meadow Valley Wash (Carlson 1974:154).

Moapa. Moapa is a railroad station and a post office. It is approximately 50 miles northeast of Las Vegas and about 2 miles northwest of I-15, in Muddy Valley (Carlson 1974:169).

Rox. Rox, named descriptively after the nature of the surroundings, is a railroad siding and pumping station 15 miles north of Moapa. It was settled in 1902, and a post office was in operation there from 1921 to 1949 (Carlson 1974:206)

Vigo. Vigo is a Union Pacific siding situated between Galt and Carp. It is also the name of a canyon which extends into Meadow Valley Wash and a manganese mining district in the Mormon Mountains (Carlson 1974:239).

Cattle and sheep ranching developed during this time, and the large stockyard at Caliente held cattle prior to shipping by rail to the Pacific Coast, Utah, and "even east as far as the middle west" (Roske and Planzo n.d.:30). The principal farm crop was hay, although other crops were also grown. Cotton, for example was grown in the 1870's, apparently successfully (Bancroft 1981:273-274). Cattle ranching continues to be an important industry in the Mormon Mountains area. The effects of regularly occurring droughts (1 to 3 years out of every decade [Roske and Planzo n.d.:25]) have been at least partially offset by such water management techniques as pitting (forming small basins or pits in the soil to catch and hold rain and runoff water), rain traps ("sloping, slightly concave, water-tight collecting area and a closed reservoir for storing the collected water," and water trough with automatic float valve [Valentine 1971:418-149]), and hauled or piped water dispensed in troughs.

Mining has continued near the Mormon Mountains area, in cycles of relatively high versus low production, The Mormon Mountains themselves were not part of any mining district in 1881 (Angel 1881:483). Gold was later mined at the Whitmore Mine and a vermiculite prospect is shown on topographic maps. Jasper was mined in the late 1920's at Paint Mine on the north side of the Mormon Mountains. The ore was trucked to Carp then shipped by rail to a roofing company in Salt Lake City (Averett 1963:78 in Planzo 1978). Mining today is of little or no consequence in the Mormon Mountains themselves.

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